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DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

CHARLES D. WALCOTT, DIRECTOR

MINERAL RESOURCES

OF THE

UNITED STATES

CALENDAR YEAR 1903

DAVID T. DAY

CHIEF OF DIVISION OF MINING AND MINERAL RESOURCES

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CONTENTS.

LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C., November 5, 1904.

SIR: I have the honor to transmit herewith the report, Mineral Resources of the United States, Calendar Year 1903, being the twentieth annual report of the series published by this Office. Besides the statistics for the calendar year 1903, considerable descriptive and technical matter, obtained while the statistical canvass was in progress, is presented. All of the material has been given such prompt publication as was possible as advance chapters 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 1904 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, 1903.

DAVID T. DAY, *Chief of Division.*

INTRODUCTION.

The arrangement and scope of this volume are practically the same as in the nineteen 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.

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 by 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.

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 25,262,360 short tons, valued at $66,459,623, 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, sublimed lead, zinc lead, litharge, and orange mineral, 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 1903.

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, 1901, and 1902.

In 1903, for the fourth time, the total value of our mineral production exceeded the enormous sum of $1,000,000,000.

The exact figures for 1903 were $1,419,721,569, as compared with $1,260,509,738 in 1902, with $1,086,552,294 in 1901, with $1,063,678,-053 in 1900, and with $972,208,008 in 1899, a gain in 1903 over 1902 of $159,211,831, or 12.63 per cent; a gain in 1903 over 1901 of $333,-169,275, or 30.66 per cent; a gain in 1903 over 1900 of $356,043,516, or 33.47 per cent; and a gain in 1903 over 1899 of $447,513,561, or 46.03 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; next, the gain of 1903 over 1902, $159,211,831, or 12.63 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 $527,079,279 in 1894, and then rising to $620,652,170 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 1903 was $344,350,000; the value of the coal, $503,724,381. The fuels increased from $469,078,842 in 1902 to $634,233,791 in 1903, a gain of $165,154,949, or 35 per cent. Every variety of fuel increased in value. Anthracite coal showed an increase in value from $76,173,586 in 1902 to $152,036,448 in 1903. The average price of anthracite coal per long ton at the mine was $2.50, as against $2.35 in 1902, the highest figure obtained up to that time since 1888, as compared with $2.05 in 1901, with $1.85 in 1900, and with $1.80 in 1899; and the average price per short ton for bituminous coal at the mine was $1.24, as compared with $1.12 in 1902. The increase in value of the bituminous coal output over 1902 was $60,829,450, a combined increase in value of coal of $136,692,312 over 1902.

The gain of $159,211,831 in the total value of our mineral production is due to the large increase in nonmetallic products, the metallic products showing a decrease from $642,258,584 in 1902 to $624,318,008 in 1903, a loss of $17,940,576, and the nonmetallic products showing an increase from $617,251,154 in 1902 to $794,403,561 in 1903, a gain of $177,152,407. 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 1903, $1,419,721,569.

The manufacture of arsenious oxide, noted for the first time in the United States in the report for 1901, was continued in 1903, but in decreased proportions, as compared with 1902.

Tin has been found in commercial quantities in South Carolina, and the mines were actively exploited during the year 1903.

METALS.

Iron and steel.—Twenty-two States produced pig iron in 1903, as against 22 in 1902, 20 in 1901, and 21 in 1900 and 1899. The total production of pig iron in 1903 was 18,009,252 long tons, against 17,821,307 tons in 1902, 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 1903 shows an increase of 187,945 long tons, or about 1.05 per cent in quantity over the production of 1902, and a decrease in value from $372,775,000 to $344,350,000, amounting to $28,425,000, or 7.6 per cent. The average price per long ton of pig iron decreased from $20.90 in 1902 to $19.07 in 1903. The average prices per long ton in recent years have been as follows: 1901, $15.25; 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 1903 amounted to 35,019,308 long tons, as compared with 35,554,135 long tons in 1902, a loss of 534,827 long tons. The value at the mines of the ore mined in 1903 was $66,328,415. As in the five preceding years, the production of iron ores in 1903 has never been equaled by any other country.

Manganese ores.—The production of manganese ores decreased from 11,995 long tons, valued at $116,722, in 1901, to 7,477 long tons, valued at $60,911, in 1902, and to 2,825 long tons, valued at $25,335, in 1903, a decrease in quantity from 1902 of 4,652 tons and in value of $35,576. The average price per ton in 1903 was $8.97, as compared with $8.15 in 1902, with $9.73 in 1901, and with $8.52 in 1900.

Gold.—The production of gold in 1903 amounted to 3,560,000 fine ounces, as compared with 3,870,000 fine ounces in 1902, with 3,805,500 fine ounces in 1901, with 3,829,897 fine ounces in 1900, and with 3,437,210 fine ounces in 1899. The value was $73,591,700, as compared with $80,000,000 in 1902, with $78,666,700 in 1901, with $79,171,000 in 1900, and with $71,053,400 in 1899.

Silver.—The coining value of the silver produced in 1903 was $70,206,060, as compared with $71,757,575 in 1902, with $71,387,800 in 1901, and with $74,533,495 in 1900. The production in 1903 was 54,300,000 fine ounces, as compared with 55,500,000 fine ounces in 1902, with 55,214,000 fine ounces in 1901, and with 57,647,000 fine ounces in 1900. The commercial value of the production in 1903 was $29,322,000, as compared with $29,415,000 in 1902, with $33,128,400 in 1901, and with $35,741,140 in 1900.

Copper.—The production of domestic copper increased from 659,508,644 pounds in 1902 to 698,044,517 pounds in 1903, an increase of 38,535,873 pounds, or about 6 per cent in quantity, and increased in value from $76,568,954 in 1902 to $91,506,006 in 1903, an increase of $14,937,052, or about 20 per cent.

Lead.—The production of lead increased to 280,000 short tons, after having been almost exactly the same for 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 1903 was $23,520,000, as compared with $22,140,000 in 1902, with $23,280,200 in 1901, and with $23,561,688 in 1900.

Zinc.—The production of zinc in 1903 showed an increase in quantity, as compared with 1902 and 1901, the production being 159,219 short tons, as compared with 156,927 short tons in 1902, with 140,822 short tons in 1901, and with 123,886 short tons in 1900. The value of the zinc production in 1903 was $16,717,995, as compared with $14,625,596 in 1902, with $11,265,760 in 1901, and with $10,654,196 in 1900.

Aluminum.—The production of aluminum during 1903 was 7,500,000 pounds, valued at $2,284,900, as compared with 7,300,000 pounds valued at $2,284,590, in 1902; 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.

Quicksilver.—The production of quicksilver during 1903 amounted to 35,620 flasks of 76½ pounds net, as compared with 34,291 flasks in 1902, with 29,727 flasks in 1901, and with 28,317 flasks in 1900. The value of the quicksilver produced in 1903 was $1,544,934, as compared with $1,467,848 in 1902, with $1,382,305 in 1901, and with $1,302,586 in 1900. California, including Nevada, reported 30,591 flasks, as compared with 28,972 flasks in 1902, and with 26,720 flasks in 1901; and Texas reported 5,029 flasks, as against 5.319 flasks in 1902, and 2,932 flasks in 1901.

Nickel.—The commercial production of metallic nickel in 1903 was 114,200 pounds, as compared with 5,748 pounds in 1902, with 6,700 pounds in 1901, with 9,715 pounds in 1900, and with 22,541 pounds in 1899. The value was $45,900, as compared with $2,701 in 1902, with $3,551 in 1901, with $3,886 in 1900, and with $8,566 in 1899. The imports of nickel in 1903 were valued at $1,493,889, as compared with $1,437,649 in 1902, with $1,849,620 in 1901, and with $1,183,884 in 1900.

Platinum.—The production of platinum from domestic ores in 1903 was 110 ounces, valued at $2,080 (not including $6,000 worth of platinum reported as contained in slimes obtained from the treatment of copper ores from the Rambler mine, Wyoming), as compared with 94 ounces, valued at $1,814, in 1902, with 1,408 ounces, valued at $27,526, in 1901, with 400 ounces, valued at $2,500, in 1900, and with 300 ounces, valued at $1,800, in 1899.

Antimony.—No antimony was obtained from domestic ores during 1903. The antimony obtained from the smelting of foreign imported ores amounted to 570 short tons, valued at $103,341, and the antimony obtained from hard lead produced from foreign and domestic lead ores was 2,558 short tons, valued at $445,092, a total production for 1903 of 3,128 short tons, valued at $548,433, as compared with 3,561 short tons, valued at $634,506, in 1902, and with 2,639 short tons, valued at $539,902, in 1901. The estimated total quantity of antimony available for consumption in 1903 was 5,475 short tons, including 2,347 short tons of imported antimony regulus, as compared with 6,255 short tons, including 2,694 short tons of imported antimony regulus, in 1902, 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.—There was no marketed production of bismuth ores in the United States during 1903 or 1902; the latest output was 318.6 short tons, of a total estimated value of $2,549, exclusive of freight and treatment charges, in 1901. The ore has been heretofore obtained at the Ballard mine, Colorado, where the metal occurs as a telluride associated with gold and silver ore. One analysis of bismuth ore from this mine, marketed but not obtained from the mine during 1903, was reported to contain 17.8 per cent of bismuth, and 9.8 ounces of gold, and 6.1 ounces of silver per ton. Another ore from the same mine was reported as containing 12.2 per cent of bismuth, and 2.11 ounces of gold and 24.45 ounces of silver per ton. In all there were 62 tons of ore containing bismuth sold during 1903, but as the ore was smelted for its gold and silver content and the bismuth was allowed to go to waste in the slag, this quantity has not been included in the statement of production. Owing to the conditions that the production of bismuth in the world far exceeds the demand, and that the control of both output and price is in the hands of a combination of interests abroad, there is no incentive to produce the metal in the United States. Moreover, the price of the refined metal is kept so low as to preclude the profitable mining of the domestic ores.

Tin.—There was no production of metallic tin in 1903, but about 19 short tons of high concentrates were shipped from South Carolina to England—value not given.

FUELS.

Coal.—For the second time in the history of the United States the production of coal in 1903 reached a total of over 300,000,000 short tons, showing an actual output of 357,356,416 tons of 2,000 pounds, valued at $503,724,381. Of this total the output of anthracite coal amounted to 66,613,454 long tons (equivalent to 74,607,068 short tons), which, as compared with the production of 36,940,710 long tons in 1902, was an increase of 29,672,744 long tons, or more than 80 per cent. This abnormal increase was due to the suspension of operations by the strike in the anthracite region from May 10 to October 23, 1902, a little over five months. The value of anthracite coal at the mines in 1903 was $152,036,448, as against $76,173,586 in 1902, and against $112,504,020 in 1901. The average value of the marketed coal sold during the year at the mines was $2.50 per long ton, the value having been $2.35 in 1902, and $2.05 in 1901.

The output of bituminous coal (which includes semianthracite and all semibituminous and lignite coals) amounted in 1903 to 282,749,348 short tons, valued at $351,687,933, as against 260,216,844 short tons, valued at $290,858,483, in 1902, and against 225,828,149 short tons, valued at $236,422,049, in 1901. The increase in the production of bituminous coal in 1903 over 1902 was, therefore, 22,532,504 tons in quantity and $60,829,450 in value. The average price per ton at the mines during 1903 was $1.24, the highest price recorded by the Survey, as against $1.12 per ton in 1902.

Coke.—The coke production of the United States in 1903 exceeded that of any year in our history, with the exception of 1902. The production, which includes the output from 1,956 retort or by-product ovens, amounted to 25,262,360 short tons, as compared with 25,401,730 short tons in 1902, with 21,795,883 short tons in 1901, and with 20,533,348 short tons in 1900. The decrease in quantity in 1903 from 1902 was only 139,370 short tons, or about 0.55 of 1 per cent. The increase in the value of coke was even more noteworthy than in 1902. The average price per ton at the ovens was the highest recorded in a period of twenty-four years, and the total value, in spite of the loss in quantity, reached the high figure of $66,459,623, an increase over 1902 of $3,120,456, or about 5 per cent, and over 1901 of $22,013,700, or 49.5 per cent.

Gas, coke, tar, and ammonia.—The aggregate value of all the products obtained from the distillation of coal in gas works and retort ovens in 1903 was $47,819,555, as compared with $43,869,440 in 1902.

Petroleum.—The total production of crude petroleum in the United States in 1903 was 100,461,337 barrels, as against 88,766,916 barrels in 1902, and 69,389,194 barrels in 1901, an increase of 11,694,421 barrels, or 13.17 per cent, over the production of 1902 and of 44.78 per cent over that of 1901. The greatest portion of the increase in 1903 came from California and Indiana, the gain over 1902 being 10,398,204 barrels, or 74.36 per cent, for California, and 1,705,515 barrels, or 22.80 per cent, for Indiana. Louisiana produced for the second time in 1903, the production being 917,771 barrels, as against 548,617 barrels in 1902. The increase over 1902 in the production of Kansas was 600,465 barrels, or about 181 per cent. Kentucky and Tennessee increased their production in 1903 by 368,955 barrels, or nearly 200 per cent. Indian Territory increased 101,811 barrels, or 274 per cent, as compared with 1902. The largest decrease in production in 1903, as compared with 1902, was in Pennsylvania, where it amounted to 708,724 barrels, or 5.87 per cent, and Ohio showed a decrease of 533,945 barrels, or 2.54 per cent. The decrease in West Virginia was 613,950 barrels, or 4.54 per cent. The percentages of production for fields show a remarkable change from 1900 to 1903. In 1900 the percentages were: Appalachian field, 57; Lima-Indiana field, 34; all other fields, nearly 9. In 1903 the respective percentages were: Appalachian field, 31.41; Lima-Indiana field, 23.97; all other fields, about 44.62. The value of crude petroleum produced during 1903 was $94,694,050, or 94.26 cents per barrel, as compared with $71,178,910, or 80.19 cents per barrel in 1902.

Natural gas.—The value of the natural gas produced in 1903 was $35,815,360, as compared with $30,867,863 in 1902, with $27,067,500 in 1901, with $23,698,674 in 1900, and with $20,074,873 in 1899—a gain of 16 per cent in 1903 over 1902.

STRUCTURAL MATERIALS.

Stone.—The value of all kinds of building stone produced in the United States during 1903 amounted to $67,960,468, as compared with $64,559,099 in 1902, 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 in the clay-working industries noted in the reports as true of 1899, 1900, 1901, and 1902 continued during 1903. The value of all clay products, as reported to this office in 1903, was $130,962,648, as compared with $122,169,531 in 1902, with $110,211,587 in 1901, and with $96,212,345 in 1900. The brick and tile products in 1903 were valued at $105,526,596, as compared with $98,042,078 in 1902, with $87,747,727 in 1901, and with $76,413,775 in 1900. The pottery products were valued in 1903 at $25,436,052, as compared with $24,127,453 in 1902, with $22,463,860 in 1901, and with $19,798,570 in 1900.

The commercial production of clay mined and sold by those not manufacturing the product themselves in 1903 was valued at $2,649,042, as compared with $2,061,072 in 1902, with $2,576,932 in 1901, and with $1,840,377 in 1900. The crude brick clay was valued at $15,000,000.

Cement.—The total production of hydraulic cement in the United States in 1903 was 29,899,140 barrels, valued at $31,931,341, as compared with 25,753,504 barrels, valued at $25,366,380, in 1902, 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 1903 was 22,342,973 barrels, valued at $27,713,319, as compared with 17,230,644 barrels, valued at $20,864,078, in 1902, 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 163 per cent and in value of about 199 per cent. The production of natural-rock cement in 1903 was 7,030,271 barrels, valued at $3,675,520, as compared with 8,044,305 barrels, valued at $4,076,630, in 1902, 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, in 1903, to 525,896 barrels, valued at $542,502, as compared with 478,555 barrels, valued at $425,672, in 1902, with 272,689 barrels, valued at $198,151, in 1901, and with 365,611 barrels, valued at $274,208, in 1900.

ABRASIVE MATERIALS.

Carborundum.—The production of carborundum in 1903 was 4,759,890 pounds, as compared with 3,741,500 pounds produced in 1902, and with 3,838,175 pounds in 1901. The value of the carborundum varies from 8 to 10 cents per pound.

Corundum and emery.—The combined production of corundum and emery in 1903 amounted to 2,542 short tons, valued at $64,102, as compared with 4,251 short tons, valued at $104,605 in 1902, and with 4,305 short tons, valued at $146,040 in 1901.

Crushed steel.—The production of crushed steel in 1903 was 755,000 pounds, as compared with 735,000 pounds in 1902, and with 690,000 pounds in 1901. The average price per pound in 1903 is quoted as about 7 cents.

Crystalline quartz.—In 1903 the production of crystalline quartz included under abrasives amounted to 8,938 short tons, valued at $76,9C8, as against 15,104 short tons, valued at $84,335, in 1902, and with 14,050 short tons, valued at $41,500, in 1901.

Garnet.—The production of abrasive garnet in the United States during 1903 amounted to 3,950 short tons, valued at $132,500, as against 3,926 short tons, valued at $132,820, in 1902, 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 price for the 1903 production is reported as $33.54 per ton.

Grindstones.—The total value of all kinds of grindstones produced during 1903 was $721,446, as compared with $667,431 in 1902, and with $580,703 in 1901. The production of 1900, valued at $710,026, was until 1903 the largest on record for any year. It should be remembered, however, that the price has decreased from $15 to $18 per ton to from $8 to $11 per ton, and that therefore the tonnage of grindstones used has correspondingly increased within the last few years. The imports for 1903 amounted in value to $85,705, as compared with $76,906 in 1902, with $88,871 in 1901, and with $92,581 in 1900.

Infusorial earth and tripoli.—In 1903 the production of infusorial earth and tripoli amounted to 9,219 short tons, valued at $76,273, as compared with 5,665 short tons, valued at $53,244, in 1902, and 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 1903 was $52,552, as against $59,808 in 1902, and against $57,179 in 1901. 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, though there was a decrease of $7,256 in 1903 as compared with 1902.

Oilstones and whetstones.—There was a decided increase in the commercial domestic production of oilstones and whetstones during 1903, the value of which amounted to $366,857, as compared with $221,762 in 1902, and with $158,300 in 1901.

CHEMICAL MATERIALS.

Arsenious oxide.—The domestic production of arsenious oxide (white arsenic) in 1903 was 611 short tons, valued at $36,696, as compared with 1,353 short tons, valued at $81,180, in 1902, and with 300 short tons, valued at $18,000, in 1901. The entire product was made by the

Puget Sound Production Company, at Everett, Wash., which began the manufacture of this important substance in 1901.

Borax.—The reported returns for 1903 gave an aggregate production of crude borax of 34,430 short tons, valued at $661,400, as compared with 17,404 short tons of refined and 2,600 short tons of crude, valued at $2,538,614, in 1902. 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 1903, including the amount of bromine contained in potassium bromide, amounted to 598,500 pounds, valued at $167,580, as compared with 513,890 pounds, valued at $128,472, in 1902, and with 552,043 pounds, valued at $154,572, in 1901. The price per pound during 1903 averaged 28 cents, as compared with 25 cents in 1902, with 28 cents in 1901, and with 29 cents in 1900.

Fluorspar.—The total commercial production of fluorspar in 1903 was 42,523 short tons, valued at $213,617, as compared with 48,018 short tons, valued at $271,832, in 1902, and with 19,586 tons, valued at $113,803, in 1901. This decrease in production was not due to any one State, but there was a large increase in production in Kentucky, and a decrease in Illinois and Arizona. The average price of crude fluorspar in 1903 was reported as $4.28 per ton, as compared with $5.19 in 1902 and with $5 in 1901, and the average price of ground fluorspar in 1903 was $9.99 per ton, as compared with $9.98 in 1902 and with $9.22 in 1901.

Gypsum.—The production of gypsum, particularly for the manufacture of calcined plaster, continues to show a remarkable gain. The output of crude gypsum in 1903 was 1,041,704 short tons, valued in its first marketable condition at $3,792,943, as compared with 816,478 short tons, valued in its first marketable condition at $2,089,341, in 1902, with 633,791 short tons, valued at $1,506,641, in 1901, and with 594,462 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 five years is attributable to the largely increased use of plaster of Paris in large modern buildings and in the manufacture of staff for temporary buildings.

Marls.—The production of marls in the United States in 1903 was 34,211 short tons, valued at $22,521; in 1902 it was 12,439 short tons, valued at $12,741.

Phosphate rock.—The total commercial production of phosphate rock reported to the Survey in 1903 amounted to 1,581,576 long tons, valued at $5,319,294, as compared with 1,490,314 long tons, valued at $4,693,444, in 1902, and with 1,483,723 long tons, valued at $5,316,403, in 1901, an increase in quantity of 1903 over 1902 of

91,262 tons and in value of $625,850. The total quantity of phosphate rock reported as mined during 1903 was 1,618,799 long tons, as compared with 1,499,617 long tons in 1902, and 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 1903 amounted to 18,968,089 barrels of 280 pounds, valued at $5,286,988, as compared with 23,849,231 barrels, valued at $5,668,636, in 1902, with 20,566,661 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 in 1903 for the manufacture of sulphuric acid amounted to 233,127 long tons, valued at $1,109,818, as compared with 207,874 long tons, valued at $947,089, in 1902, and with a combined production of 241,691 long tons, valued at $1,257,879, in 1901. 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 1903 was 50,397 short tons, valued at $152,150, as compared with 61,668 short tons, valued at $203,154, in 1902, and with 49,070 short tons, valued at $157,844, in 1901.

Cobalt oxide.—The domestic production of cobalt oxide in 1903 was 120,000 pounds, valued at $228,000, not including the value of 60 short tons of cobalt ore, as against 3,730 pounds, valued at $6,714, in 1902, and against 13,360 pounds, valued at $24,048, in 1901. All the cobalt oxide was obtained as a by-product in smelting lead ores at Mine Lamotte, Missouri.

Mineral paints.—The commercial production of mineral paints in 1903 amounted to 62,122 short tons, valued at $646,222, as compared with 73,049 short tons, valued at $944,332, in 1902, and with 61,460 short tons, valued at $789,962, in 1901.

Zinc white.—The production of zinc white in 1902 amounted to 62,962 short tons, valued at $4,801,718, as compared with 52,645 short tons, valued at $4,016,499, in 1902, and with 46,500 short tons, valued at $3,720,000, in 1901.

MISCELLANEOUS.

Asbestos.—The asbestos commercially produced in the United States in 1903 was obtained chiefly from the mines at Sall Mountain, White County, Ga., but a small quantity was mined at Dalton, Berkshire County, Mass., New Hartford, Conn., and Grand Canyon, Ariz. The total commercial production was 887 short tons, valued at $16,760, as compared with 1,005 short tons, valued at $16,200, in 1902, and with 747 short tons, valued at $13,498, in 1901.

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 in 1903 was 101,255 short tons, valued at $1,005,446, as compared with 105,458 short tons, valued at $765,048, in 1902, and with 63,134 short tons, valued at $555,335, in 1901.

Bauxite.—In 1903 the production of bauxite was 48,087 long tons, valued at $171,306, as compared with 29,222 long tons, valued at $128,206, in 1902, and 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 only State producing chromite during 1903, the quantity being 150 long tons, valued at $2,250, as compared with 315 long tons, valued at $4,567, in 1902, and with 368 long tons, valued at $5,790, in 1901.

Feldspar.—The production of feldspar in 1903 was 41,891 short tons, valued at $256,733, as against 45,287 short tons, valued at $250,-424, in 1902, and 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 1903 the production was 60,230 short tons, valued at $421,600 as compared with 71,100 short tons, valued at $615,350, in 1902, and with 69,200 short tons, valued at $483,600, in 1901.

Flint.—The production of flint in 1903 was 55,233 short tons, valued at $156,947, as against 36,365 short tons, valued at $144,209, in 1902, and against 34,420 short tons, valued at $149,297, in 1901.

Fuller's earth.—As reported to the Survey, the production of fuller's earth in 1903 was 20,693 short tons, valued at $190,277, as compared with 11,492 short tons, valued at $98,144, in 1902, and with 14,112 short tons, valued at $96,835, in 1901. The largest production of fuller's earth hitherto obtained was in 1897, the output being 17,113 short tons.

Glass sand.—The production of glass sand in 1903 was 823,044 short tons, valued at $855,828, as compared with 943,135 short tons, valued at $807,797 in 1902.

Graphite.—The commercial production of crystalline graphite during 1903 amounted to 4,538,155 pounds, valued at $154,170, as compared with 3,936,824 pounds, valued at $126,144, in 1902, with 3,967,612 pounds, valued at $135,914, in 1901, and with 5,507,855 pounds, valued at $178,761, in 1900. The production of amorphous graphite in 1903 was 16,591 short tons, valued at $71,384, as compared with 4,739 short tons, valued at $55,964, in 1902, with 809 short tons, valued at $31,800, in 1901, and with 611 short tons, valued at $18,818, in 1900. The production of artificial graphite was 2,620,000 pounds, valued $178,670, the average price being 6.82 cents per pound, as compared with 2,358,828 pounds, valued at $110,700, in 1902, the average price being 4.69 cents per pound, and 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 1903 was 12,029,719 long tons, valued at $5,423,732, as compared with 12,139,248 long tons, valued at $5,271,252, in 1902, 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.

Lithium.—The production of lithium minerals in 1903 was 1,155 short tons, valued at $23,425 at the railroad, as against 1,245 short tons, valued at $25,750, in 1902. There is an increase in the demand for these minerals from foreign chemical manufacturers.

Magnesite.—The production of magnesite in the United States continues to be limited to California, and during the year 1903 the commercial production reported was 3,744 short tons, valued at $10,595, as compared with 2,830 short tons, valued at $8,490, in 1902.

Mica.—The total production of mica in 1903 was valued at $59,118, as compared with a total value of $118,849 for the production of 1902.

Mineral waters.—The total production of mineral waters in 1903 was 51,242,757 gallons, valued at $9,041,078, as compared with 64,859,451 gallons, valued at $8,793,761, in 1902, and with 55,771,188 gallons, valued at $7,586,962, in 1901.

Molybdenum.—The commercial production of molybdenum in 1903 was 795 short tons of concentrates, valued at $60,865. The value of these molybdenum ores fluctuates very greatly, the highest price quoted being $1,500 per ton and the lowest $100.

Monazite and zircon.—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 1903 this amounted to 862,000 pounds, valued at $64,630, and 3,000 pounds of zircon, valued at $570, as compared with 802,000 pounds of monazite, valued at $64,160, in 1902, and with 748,736 pounds, valued at $59,262, in 1901. The price per pound received by the miners for the crude monazite sand produced in 1903 varied from 2½ to 6 cents, according to the percentage of thoria.

Precious stones.—The value of the gems and precious stones found in the United States in 1903 was $321,400, as compared with $328,450 in 1902, 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 amethysts found in North Carolina and Connecticut; the turquoises from New Mexico, Arizona, Nevada, and California; the fine-colored and deep-blue sapphhires found in Montana; the colored tourmalines of San Joaquin County, Cal.; the chrysoprases from Visalia, Tulare County, Cal.; the garnets of Arizona and New Mexico, and the pale-purple garnets of North Carolina.

Pumice stone.—The production of pumice amounted in 1903 to 885 short tons, valued at $2,665, as against 700 short tons, valued at $2,750 in 1902.

Rutile.—No production of rutile was reported in 1903, the supply on hand being sufficient for the demands of the trade.

Talc and soapstone.—Exclusive of the production of fibrous talc from Gouverneur, N. Y., the production of talc and soapstone in 1903 amounted to 26,671 short tons, valued at $418,460, as compared with 26,854 short tons, valued at $525,157 in 1902, and with 28,643 tons, valued at $424,888 in 1901. 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.

Tungsten.—The commercial production of concentrated tungsten ores during 1903 amounted to 292 short tons, valued at $43,639, as against 184 short tons in 1902, of which not more than a few tons were sold. 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.—The production of uranium and vanadium minerals in 1903, as reported to the Survey, amounted to 30 short tons of concentrates, equivalent to about 19 short tons of metal, valued at $5,625, as compared with 3,810 short tons, valued at $48,125 in 1902. This, of course, represents the crude ore.

Mineral products of the United

	Products.	1902. Quantity.	1902. Value.
	METALLIC.		
1	Pig iron, spot value.......long tons..	17,821,307	$372,775,000
2	Silver, coining value.......troy ounces..	55,500,000	71,757,575
3	Gold, coining value.......do....	3,870,000	80,000,000
4	Copper, value at New York City.......pounds..	659,508,644	76,568,954
5	Lead, value at New York City.......short tons..	270,000	22,140,000
6	Zinc, value at New York City.......do....	156,927	14,625,596
7	Quicksilver, value at San Francisco.......flasks..	34,291	1,467,848
8	Aluminum, value at Pittsburg.......pounds..	7,300,000	2,284,590
9	Antimony, value at San Francisco.......short tons..	3,561	634,506
10	Nickel, value at Philadelphia.......pounds..	5,748	2,701
11	Tin.......do....	....	....
12	Platinum, value (crude) at San Francisco.......troy ounces..	94	1,814
13	Total value of metallic products.......	....	642,258,584
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal.......short tons..	260,216,844	290,858,483
15	Pennsylvania anthracite.......long tons..	36,940,710	76,173,586
16	Natural gas.......	....	30,867,863
17	Petroleum.......barrels..	88,766,916	71,178,910
18	Brick clay.......	....	15,000,000
19	Cement.......barrels..	25,753,504	25,366,380
20	Stone.......	....	64,559,099
21	Corundum and emery.......short tons..	4,251	104,605
22	Crystalline quartz.......do....	15,104	84,335
23	Garnet for abrasive purposes.......do....	3,926	132,820
24	Grindstones.......	....	667,431
25	Infusorial earth and tripoli.......short tons..	5,665	53,244
26	Millstones.......	....	59,808
27	Oilstones, etc.......	....	221,762
28	Arsenious oxide.......short tons..	1,353	81,180
29	Borax, refined.......do....	17,404	2,447,614
	Borax, crude.......do....	2,600	91,000
30	Bromine.......pounds..	513,890	128,472
31	Fluorspar.......short tons..	48,018	271,832
32	Gypsum.......do....	816,478	2,089,341
33	Lithium.......do....	1,245	25,750
34	Marls.......do....	12,439	12,741
35	Phosphate rock.......long tons..	1,490,314	4,693,444
36	Pyrite.......do....	} c 207,874	947,089
37	Sulphur.......do....	}	
38	Salt.......barrels..	23,849,231	5,668,636
39	Barytes, crude.......short tons..	61,668	203,154
40	Cobalt oxide.......pounds..	3,730	6,714
41	Mineral paints.......short tons..	73,049	944,332
42	Zinc white.......do....	52,645	4,016,499
43	Asbestos.......do....	1,005	16,200
44	Asphaltum.......do....	105,458	765,048
45	Bauxite.......long tons..	29,222	128,206
46	Chromic iron ore.......do....	315	4,567
47	Clay (all other than brick).......short tons..	1,455,357	2,061,072
48	Feldspar.......do....	45,287	250,424
49	Fibrous talc.......do....	71,100	615,350
50	Flint.......do....	36,365	144,209
51	Fuller's earth.......do....	11,492	98,144
52	Glass sand.......do....	943,135	807,797
53	Graphite, crystalline.......pounds..	3,936,824	} 182,108
	Graphite, amorphous.......short tons..	4,739	}
54	Limestone for iron flux.......long tons..	12,139,248	5,271,252
55	Magnesite.......short tons..	2,830	8,490
56	Manganese ore.......long tons..	7,477	60,911
57	Mica, sheet.......pounds..	373,266	83,843
	Mica, scrap.......short tons..	1,400	35,006
58	Mineral waters.......gallons sold..	64,859,451	8,793,761
59	Monazite.......pounds..	802,000	64,160
60	Zircon.......do....	....	....
61	Precious stones.......	....	328,450
62	Pumice stone.......short tons..	700	2,750
63	Rutile.......pounds..	....	....
64	Talc and soapstone.......short tons..	26,854	525,157
65	Uranium and vanadium.......do....	3,810	48,125
66	Total value of nonmetallic mineral products.......	....	617,251,154
67	Total value of metallic products.......	....	642,258,584
68	Estimated value of mineral products unspecified.......	....	1,000,000
69	Grand total.......	....	1,260,509,738

a No metallic tin; between 19 and 20 short tons of high-grade concentrates shipped to England from South Carolina.

b Not including $6,000 worth of platinum reported as contained in slimes from copper ore from the Rambler mine, Wyoming.

States in 1902 and 1903.

1903.		Increase (+) or decrease (−) in 1903.		Per cent of increase (+) or decrease (−).		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
18,009,252	$344,350,000	+ 187,945	−$28,425,000	+ 1.05	− 7.63	1
51,300,000	70,206,060	− 1,200,000	− 1,551,515	− 2.16	− 2.16	2
3,560,000	73,591,700	− 310,000	− 6,408,300	− 8.01	− 8.01	3
698,044,517	91,506,006	+38,535,873	+ 14,937,052	+ 5.84	+ 19.51	4
280,000	23,520,000	+ 10,000	+ 1,380,000	+ 3.70	+ 6.23	5
159,219	16,717,995	+ 2,292	+ 2,092,399	+ 1.46	+ 14.31	6
35,620	1,544,934	+ 1,829	+ 77,086	+ 3.88	+ 5.25	7
7,500,000	2,284,900	+ 200,000	+ 310	+ 2.74	+ .01	8
3,128	548,433	− 433	− 86,073	− 12.16	− 13.56	9
114,200	45,900	+ 108,452	+ 43,199	+1,886.78	+1,599.37	10
(a)	....	....	....	....	....	11
110	b 2,080	+ 16	+ 266	+ 17.02	+ 14.66	12
....	624,318,008	....	− 17,940,576	....	− 2.79	13
282,749,348	351,687,933	+22,532,504	+ 60,829,450	+ 8.66	+ 20.91	14
66,613,454	152,036,448	+29,672,744	+ 75,862,862	+ 80.33	+ 99.59	15
....	35,815,360	....	+ 4,947,497	....	+ 16.03	16
100,461,337	94,694,050	+11,694,421	+ 23,515,140	+ 13.17	+ 33.04	17
....	15,000,000	....	....	....	....	18
29,899,140	31,931,341	+ 4,145,636	+ 6,564,961	+ 16.10	+ 25.88	19
....	67,960,468	....	+ 3,401,369	....	+ 5.27	20
2,542	64,102	− 1,709	− 40,503	− 42.02	− 38.72	21
8,938	76,908	− 6,166	− 7,427	− 40.82	− 8.81	22
3,950	132,500	+ 24	− 320	+ .61	− .24	23
....	721,446	....	+ 54,015	....	+ 8.09	24
9,219	76,273	+ 3,554	+ 23,029	+ 62.74	+ 43.25	25
....	52,552	....	− 7,256	....	− 12.18	26
....	866,857	....	+ 145,095	....	+ 65.43	27
611	36,696	− 742	− 44,484	− 54.84	− 54.80	28
Crude, 34,430	661,400	....	....	....	....	29
598,500	167,580	+ 84,610	+ 39,108	+ 16.46	+ 30.44	30
42,528	213,617	− 5,495	− 58,215	− 11.44	− 21.42	31
1,041,704	3,792,943	+ 225,226	+ 1,708,602	+ 27.59	+ 81.54	32
1,155	23,425	− 90	− 2,325	− 7.23	− 9.03	33
34,211	22,521	+ 21,772	+ 9,780	+ 175.03	+ 76.76	34
1,581,576	5,319,294	+ 91,262	+ 625,850	+ 6.12	+ 13.33	35
c 233,127	1,109,818	+ 25,253	+ 162,729	+ 12.15	+ 17.18	36 37
18,968,069	5,286,988	− 4,881,142	− 381,648	− 20.47	− 6.73	38
50,397	152,150	− 11,271	− 51,004	− 18.28	− 25.11	39
120,000	d 228,000	+ 116,270	+ 221,286	+3,117.16	+3,295.89	40
62,122	646,222	− 10,927	− 298,110	− 14.96	− 31.57	41
62,962	4,801,718	+ 10,317	+ 785,219	+ 19.60	+ 19.55	42
887	16,760	− 118	+ 560	− 11.74	+ 3.46	43
101,255	1,005,446	− 4,208	+ 240,398	− 3.99	+ 31.42	44
48,087	171,306	+ 18,865	+ 43,100	+ 64.56	+ 33.62	45
150	2,250	− 165	− 2,317	− 52.38	− 50.73	46
1,650,835	2,649,042	+ 195,478	+ 587,970	+ 13.43	+ 28.53	47
41,891	256,733	− 3,396	+ 6,309	− 7.50	+ 2.52	48
60,230	421,600	− 10,870	− 193,750	− 15.29	− 31.49	49
55,238	156,947	+ 18,868	+ 12,738	+ 51.89	+ 8.83	50
20,693	190,277	+ 9,201	+ 92,133	+ 80.06	+ 93.88	51
823,044	855,828	− 120,091	+ 48,031	− 12.73	+ 5.95	52
4,538,155 16,591	225,554	+ 601,331 + 11,852	+ 43,446	+ 15.27 + 250.09	+ 23.86	53
12,029,719	5,423,732	− 109,529	+ 152,480	− .90	+ 2.89	54
3,744	10,595	+ 914	+ 2,105	+ 32.30	+ 24.79	55
2,825	25,335	− 4,652	− 35,576	− 62.22	− 58.41	56
90,100	17,128	− 283,166	− 66,715	− 75.86	− 79.57	57
1,693	41,990	+ 298	+ 6,984	+ 2.09	+ 19.95	
51,242,757	9,041,078	−18,616,694	+ 247,317	− 20.99	+ 2.81	58
862,000	64,630	+ 60,000	+ 470	+ 7.48	+ .73	59
3,000	570	+ 3,000	+ 570	....	....	60
....	321,400	....	− 7,050	....	− 2.15	61
886	2,665	+ 185	− 85	+ 26.43	− 3.09	62
....	....	....	....	....	....	63
26,671	418,460	− 183	− 106,697	− .68	− 20.32	64
19	5,625	− 3,791	− 42,500	− 99.50	− 88.31	65
....	794,408,561	....	+177,152,407	....	+ 28.70	66
....	624,318,008	....	− 17,940,576	....	− 2.79	67
....	1,000,000	....	....	....	....	68
....	1,419,721,569	....	+159,211,831	....	+ 12.63	69

c Included under pyrite in 1901, 1902, and 1903.
d Not including value of 60 short tons of cobalt ore produced in Idaho.

Mineral products of the United S

	Product.	1880.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron, value at Philadelphia.......long tons..	3,375,912	$89,315,
2	Silver, coining value.......troy ounces..	30,320,000	39,200,
3	Gold, coining value.......do....	1,741,500	36,000,
4	Copper, value at New York City.......pounds..	60,480,000	11,491,
5	Lead, value at New York City.......short tons..	97,825	9,782,
6	Zinc, value at New York City.......do....	23,239	2,277,
7	Quicksilver, value at San Francisco.......flasks..	59,926	1,797,
8	Nickel, value at Philadelphia.......pounds..	233,893	257,
9	Aluminum, value at Pittsburg.......do....	....	....
10	Antimony, value at San Francisco.......short tons..	50	10
11	Platinum (crude), value at San Francisco.......troy ounces..	100	
12	Total value of metallic products..........	....	190,132
	NONMETALLIC (SPOT VALUES).		
13	Bituminous coal.......long tons..	38,242,641	53,44
14	Pennsylvania anthracite.......do....	25,580,189	42,19
15	Stone..........	....	18,35
16	Petroleum.......barrels..	26,286,123	24,18
17	Lime.......do....	28,000,000	19,00
18	Natural gas..........	....	....
19	Cement.......barrels..	2,072,943	1,85
20	Salt.......do....	5,961,060	4,82
21	Phosphate rock.......long tons..	211,377	1,12
22	Limestone for iron flux.......do....	4,500,000	3,80
23	Mineral waters.......gallons sold..	2,000,000	50
24	Zinc white.......short tons..	10,107	76
25	Potters' clay.......do....	28,877	20
26	Mineral paints.......do....	3,604	13
27	Borax.......pounds..	3,692,443	27
28	Gypsum.......short tons..	90,000	40
29	Grindstones..........	....	50
30	Fibrous talc.......short tons..	4,210	5
31	Pyrite.......long tons..	2,000	
32	Soapstone.......short tons..	8,441	6
33	Manganese ore.......long tons..	5,761	8
34	Asphaltum.......short tons..	444	
35	Precious stones..........	....	10
36	Bromine.......pounds..	404,690	1
37	Corundum.......short tons..	1,044	
38	Barytes (crude).......do....	20,000	
39	Graphite.......pounds..	....	
40	Millstones..........	....	2
41	Oilstones, etc. [a].......pounds..	420,000	
42	Marls.......short tons..	1,000,000	5
43	Flint.......long tons..	20,000	
44	Fluorspar.......short tons..	4,000	
45	Chromic iron ore.......long tons..	2,288	
46	Infusorial earth.......short tons..	1,833	
47	Feldspar.......long tons..	12,500	
48	Mica.......pounds..	81,669	1
49	Cobalt oxide.......do....	7,251	
50	Slate ground as a pigment.......short tons..	1,000	
51	Sulphur.......do....	600	
52	Asbestos.......do....	150	
53	Rutile.......pounds..	100	
54	Lithographic stone.......short tons..	....	....
55	Total value of nonmetallic mineral products..........	....	173,
56	Total value of metallic products..........	....	190,
57	Estimated value of mineral products unspecified..........	....	6,
58	Grand total..........	....	369,

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

for the calendar years 1880–1903.

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	12,822,719	5
26,800	2,680,000	33,765	8,646,620	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	809,777	58,800	52,920	8
....	....	....	....	88	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	6,412,873	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	78,425	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	3,000	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 ....troy 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	....	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 1880-1903—Continued.

1885.		1886.		1887.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,044,425	$64,712,400	5,683,329	$95,196,760	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	80,193	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 fo

	Product.	1888.	
		Quantity.	Value.
	METALLIC.		
1	Pig iron, value at Philadelphia ....long tons..	6,489,738	$107,000,00
2	Silver, coining value...................................troy ounces..	45,783,632	59,195,00
3	Gold, coining value.......................................do....	1,604,927	33,175,00
4	Copper, value at New York City ....pounds..	231,270,622	33,833,95
5	Lead, value at New York City..........................short tons..	151,919	13,399,25
6	Zinc, value at New York City ....do....	55,903	5,500,85
7	Quicksilver, value at San Francisco ....flasks..	33,250	1,413,12
8	Aluminum, value at Pittsburg ....pounds..	19,000	65,0
9	Antimony, value at San Francisco ....short tons..	100	20,0
10	Nickel, value at Philadelphia...............................pounds..	204,328	127,6
11	Tin ....do....	....	....
12	Platinum (crude), value at San Francisco............troy ounces..	500	2,0
13	Total value of metallic products..	....	253,731,8
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal...short tons..	102,039,838	101,860,5
15	Pennsylvania anthracite..................................long tons..	41,624,611	89,020,4
16	Stone	....	25,500,
17	Petroleum ....barrels..	27,612,025	17,947,
18	Natural gas	....	22,629,
19	Brick clay..	....	7,500.
20	Clay (all other than brick)............................short tons..	41,160	300,
21	Cement...barrels..	6,503,295	5,021,
22	Mineral waters...gallons sold..	9,578,648	1,679,
23	Phosphate rock ....long tons..	448,567	2,018,
24	Salt...barrels..	8,055,881	4,374,
25	Limestone for iron flux ....long tons..	5,438,000	2,719,
26	Zinc white ....short tons..	20,000	1,600,
27	Gypsum ....do....	110,000	550,
28	Borax ....pounds..	7,589,000	455,
29	Mineral paints...short tons..	26,500	405,
30	Grindstones...	....	281.
31	Fibrous talc ....short tons..	20,000	210,
32	Asphaltum ....do....	53,800	331,
33	Soapstone ....do....	15,000	250,
34	Precious stones	....	139,
35	Pyrite...long tons..	54,331	167,
36	Corundum...short tons..	589	91,
37	Oilstones, etc.[a] ....pounds..	1,500,000	18
38	Mica ....do....	48,000	70
39	Barytes (crude) ....short tons..	20,000	110
40	Bromine ....pounds..	307,386	95
41	Fluorspar...short tons..	6,000	30
42	Feldspar ....long tons..	8,700	50
43	Manganese ore ....do....	29,198	279
44	Flint ....do....	30,000	127
45	Graphite ....pounds..	400,000	33
46	Bauxite ....long tons..	....	....
47	Sulphur ....short tons..	....	....
48	Marls..do....	300,000	15
49	Infusorial earth ....do....	1,500	7
50	Millstones	....	81
51	Chromic iron ore..long tons..	1,500	2
52	Cobalt oxide ....pounds..	8,491	1
53	Magnesite ....short tons..	....	....
54	Asbestos...do....	100	[illegible]
55	Rutile..pounds..	1,000	[illegible]
56	Ozocerite (refined) ....do....	43,500	[illegible]
57	Total value of nonmetallic mineral products..........................	....	286,15
58	Total value of metallic products	....	253,73
59	Estimated value of mineral products unspecified...................	....	90
60	Grand total	....	540,78

a Prior to 1889 quantity and value are for rough stone quarried; since 1890 they are for finished pr

the calendar years 1880–1903—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	66,396,686	54,500,000	70,464,645	58,330,000	75,416,565	2
1,590,869	32,886,180	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
...	267,246,167	...	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	47,782	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
98,705	202,119	99,854	273,745	106,536	338,880	35
2,245	105,565	1,970	89,895	2,265	90,230	36
5,982,000	82,980	...	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	58,985	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
...	267,246,167	...	305,872,422	...	300,403,748	58
...	1,000,000	...	1,000,000	...	1,000,000	59
...	550,869,979	...	619,648,925	...	623,171,594	60

Mineral products of the United States f

	Product.	1892. Quantity.	Value.
	METALLIC.		
1	Pig iron, spot value ... long tons	9,157,000	$131,161,0
2	Silver, coining value ... troy ounces	63,500,000	82,101,0
3	Gold, coining value ... do	1,596,375	33,000,0
4	Copper, value at New York City ... pounds	352,971,744	37,977,1
5	Lead, value at New York City ... short tons	173,654	13,892,3
6	Zinc, value at New York City ... do	87,260	8,027,9
7	Quicksilver, value at San Francisco ... flasks	27,993	1,245,6
8	Aluminum, value at Pittsburg ... pounds	259,885	172,8
9	Antimony, value at San Francisco ... short tons	1,790	276,4
10	Nickel, value at Philadelphia ... pounds	92,252	50,7
11	Tin ... do	162,000	32,4
12	Platinum, value (crude) at San Francisco ... troy ounces	80	5
13	Total value of metallic products	...	307,938,
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal ... short tons	126,856,567	125,124,
15	Pennsylvania anthracite ... long tons	46,850,450	82,442,
16	Natural gas	...	14,800,
17	Petroleum ... barrels	50,509,136	26,034,
18	Brick clay	...	9,000,
19	Cement ... barrels	8,758,621	7,152,
20	Stone	...	48,706,
21	Corundum and emery ... short tons	1,771	181,
22	Crystalline quartz ... do	...	...
23	Garnet for abrasive purposes ... do	...	...
24	Grindstones	...	272
25	Infusorial earth and tripoli ... short tons	...	43
26	Millstones	...	23
27	Oilstones, etc	...	146
28	Borax ... pounds	13,500,000	900
29	Bromine ... do	379,480	64
30	Fluorspar ... short tons	12,250	89
31	Gypsum ... do	256,259	695
32	Marls ... do	125,000	65
33	Phosphate rock ... long tons	681,571	3,29
34	Pyrite ... do	109,788	305
35	Salt ... barrels	11,698,890	5,65
36	Sulphur ... short tons	2,688	8
37	Barytes (crude) ... do	32,108	13
38	Cobalt oxide ... pounds	7,869	1
39	Mineral paints ... short tons	51,704	76
40	Zinc white ... do	27,500	2,20
41	Asbestos ... do	104	
42	Asphaltum ... do	87,680	44
43	Bauxite ... long tons	10,518	3
44	Chromic iron ore ... do	1,500	2
45	Clay (all other than brick) ... short tons	470,400	1,0
46	Feldspar ... do	16,800	7
47	Fibrous talc ... do	41,925	47
48	Flint ... do	22,400	8
49	Fuller's earth ... do	...	...
50	Graphite ... pounds	...	10
51	Limestone for iron flux ... long tons	5,172,114	3,6
52	Magnesite ... short tons	1,004	
53	Manganese ore ... long tons	13,613	1
54	Mica ... pounds	75,000	1
55	Mineral waters ... gallons sold	21;876,604	4,9
56	Monazite ... pounds	...	...
57	Ozocerite (refined) ... do	60,000	
58	Precious stones	...	3
59	Pumice stone ... short tons	...	...
60	Rutile ... pounds	100	
61	Soapstone ... short tons	23,908	4
62	Total value of nonmetallic mineral products	...	339,
63	Total value of metallic products	...	307,
64	Estimated value of mineral products unspecified	...	1,
65	Grand total	...	648,

the calendar years 1880–1903—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	77,576,000	49,501,122	64,000,000	55,727,000	72,051,000	2
1,739,081	35,955,000	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	....	....	....	....	11
75	517	100	600	150	900	12
....	250,212,649	....	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	85,522,095	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	....	83,319,131	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	879,444	102,450	517,421	134,343	29
12,400	84,000	7,500	47,500	4,000	24,000	30
258,615	696,615	289,312	761,719	265,503	807,447	31
75,000	40,000	75,000	40,000	60,000	80,000	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	4,054,668	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	530,884	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	18,525	41
47,779	372,232	60,570	853,400	68,163	848,281	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	89,906	435,060	89,240	870,895	47
83,281	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	8,698,550	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	1,578,000	137,150	56
....	....	....	....	....	....	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
....	250,212,649	....	218,382,494	....	281,479,931	63
....	1,000,000	....	1,000,000	....	1,000,000	64
....	574,469,967	....	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 .... troy 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...	....	....
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....	....	....
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 1880–1903—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
....	....	....	....	....	....	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	79,301,954	47,663,076	75,414,537	53,944,647	88,142,130	15
....	13,826,422	....	15,296,818	....	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	8,812	23,990	13,600	39,000	22
2,554	80,853	2,967	86,850	2,765	98,825	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
1,089,345	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	76,837	675,649	75,065	553,904	42
20,590	57,652	25,149	75,437	35,280	125,598	43
....	....	....	....	....	....	44
563,115	978,448	585,450	1,384,766	843,279	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
11,106	96,505	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
....	....	....	....	....	....	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
....	327,684,375	....	353,848,520	....	445,428,451	64
....	302,531,147	....	343,748,268	....	525,779,557	65
....	1,000,000	....	1,000,000	....	1,000,000	66
....	631,215,522	....	698,596,788	....	972,208,008	67

Mineral products of the United States for the calendar years 1880–1903—Continued.

Product.	1900. Quantity.	1900. Value.
METALLIC.		
Pig iron, spot value .... long tons..	13,789,242	$259,944,(
Silver, coining value .... troy ounces..	57,647,000	74,533,
Gold, coining value .... do....	3,829,897	79,171,(
Copper, value at New York City .... pounds..	606,117,166	98,494,(
Lead, value at New York City .... short tons..	270,824	23,561,(
Zinc, value at New York City .... do....	123,886	10,654,
Quicksilver, value at San Francisco .... flasks..	28,317	1,302,
Aluminum, value at Pittsburg .... pounds..	7,150,000	1,920,
Antimony, value at San Francisco .... short tons..	4,226	837,
Nickel, value at Philadelphia .... pounds..	9,715	3,
Tin .... do....	....	....
Platinum, value (crude) at San Francisco .... troy ounces..	400	2.
Total value of metallic products	....	550,425,
NONMETALLIC (SPOT VALUES).		
Bituminous coal .... short tons..	212,316,112	220,930,
Pennsylvania anthracite .... long tons..	51,221,353	85,757
Natural gas	....	23,698
Petroleum .... barrels..	63,620,529	75,989
Brick clay	....	12,000
Cement .... barrels..	17,231,150	13,28
Stone	....	41,32
Corundum and emery .... short tons..	4,305	10
Crystalline quartz .... do....	14,461	4(
Garnet for abrasive purposes .... do....	3,185	12
Grindstones	....	71(
Infusorial earth and tripoli .... short tons..	3,615	2
Millstones	....	3
Oilstones, etc	....	17
Borax .... short tons..	a1,602	17
	b24,235	84
Bromine .... pounds..	521,444	14
Fluorspar .... short tons..	18,450	9
Gypsum .... do....	594,462	1,62
Lithium .... do....	520	....
Marls .... do....	60,000	[illegible]
Phosphate rock .... long tons..	1,491,216	5,3
Pyrite .... do....	204,615	7
Salt .... barrels..	20,869,342	6,9
Sulphur .... short tons..	3,525	[illegible]
Barytes (crude) .... do....	67,680	1
Cobalt oxide .... pounds..	6,471	
Mineral paints .... short tons..	72,222	8
Zinc white .... do....	48,840	3,6
Asbestos .... do....	1,054	
Asphaltum .... do....	54,389	4
Bauxite .... long tons..	23,184	
Chromic iron ore .... do....	140	
Clay (all other than brick) .... short tons..	1,221,660	1,8
Feldspar .... do....	24,821	1
Fibrous talc .... do....	63,500	4
Flint .... do....	32,495	
Fuller's earth .... do....	9,698	
Graphite (crystalline) .... pounds..	5,507,855	1
Graphite (amorphous) .... short tons..	611	
Limestone for iron flux .... long tons..	7,495,435	3,(
Magnesite .... short tons..	2,252	
Manganese ore .... long tons..	11,771	
Mica (sheet) .... pounds..	456,283	
Mica (scrap) .... short tons..	5,497	
Mineral waters .... gallons sold..	47,558,784	6,
Monazite .... pounds..	908,000	
Ozocerite (refined) .... do....	....	....
Precious stones	....	
Pumice stone .... short tons..	....	....
Rutile .... pounds..	300	
Soapstone .... short tons..	27,943	
Total value of nonmetallic mineral products	....	512,
Total value of metallic products	....	550,
Estimated value of mineral products unspecified	....	1,
Grand total	....	1,063,

a Refined. b Crude.

Mineral products of the United States for the calendar years 1880–1903—Continued.

Product.	1901. Quantity.	1901. Value.
METALLIC.		
Pig iron, spot value ....long tons..	15,878,354	$242,174,000
Silver, coining value ....troy 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	539,902
Nickel, value at Philadelphia ....pounds..	6,700	3,551
Tin ....do....	....	....
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....	a5,344 b17,887	697,307 314,811
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) ....short tons..	1,367,170	2,576,932
Feldspar ....do....	31,711	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..	3,500	10,500
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....	....	....
Precious stones	....	289,050
Pumice stone ....short tons..	....	....
Rutile ....pounds..	41,250	5,710
Soapstone ....short tons..	28,643	424,888
Uranium and vanadium ....do....	375	....
Total value of nonmetallic mineral products		567,286,035
Total value of metallic products		518,266,259
Estimated value of mineral products unspecified	....	1,000,000
Grand total		1,086,552,294

a Refined. b Crude. c Combined with pyrite.

Mineral products of the United States for the calendar years 1880–1903—Continued.

Product.	1902.	
	Quantity.	Value.
METALLIC.		
Pig iron (spot value) .... long tons..	17,821,307	$372,775,
Silver, coining value .... troy ounces..	55,500,000	71,757,
Gold, coining value .... do....	3,870,000	80,000,
Copper, value at New York City .... pounds..	659,508,644	76,568,
Lead, value at New York City .... short tons..	270,000	22,140,
Zinc, value at New York City .... do....	156,927	14,625,
Quicksilver, value at San Francisco .... flasks..	34,291	1,467,
Aluminum, value at Pittsburg .... pounds..	7,300,000	2,284,
Antimony, value at San Francisco .... short tons..	3,561	634,
Nickel, value at Philadelphia .... pounds..	5,748	2,
Tin .... do....	....	....
Platinum, value (crude) at San Francisco .... troy ounces..	94	1,
Total value of metallic products	....	642,258,
NONMETALLIC (SPOT VALUES).		
Bituminous coal .... short tons..	260,216,844	290,858,
Pennsylvania anthracite .... long tons..	36,940,710	76,173,
Natural gas	....	80,867
Petroleum .... barrels..	88,766,916	71,178
Brick clay	....	15,000
Cement .... barrels..	25,753,504	25,366
Stone	....	64,559
Corundum and emery .... short tons..	4,251	104
Crystalline quartz .... do....	15,104	84
Garnet for abrasive purposes .... do....	3,926	132
Grindstones	....	667
Infusorial earth and tripoli .... short tons..	5,665	5
Millstones	....	5
Oilstones, etc	....	22
Arsenious oxide .... short tons..	1,353	8
Borax (refined) .... do....	17,404	2,44
Borax (crude) .... do....	2,600	9
Bromine .... pounds..	513,890	12
Fluorspar .... short tons..	48,018	27
Gypsum .... do....	816,478	2,08
Lithium .... do....	1,245	2
Marls .... do....	12,439	1
Phosphate rock .... long tons..	1,490,314	4,69
Pyrite .... do....	207,874	94
Salt .... barrels..	23,849,231	5,66
Sulphur	(a)	(a)
Barytes (crude) .... short tons..	61,668	2
Cobalt oxide .... pounds..	3,730	
Mineral paints .... short tons..	73,049	9
Zinc white .... do....	52,645	4,0
Asbestos .... do....	1,005	
Asphaltum .... do....	105,458	7
Bauxite .... long tons..	29,222	1
Chromic iron ore .... do....	315	
Clay (all other than brick) .... short tons..	1,455,357	2,0
Feldspar .... do....	45,287	2
Fibrous talc .... do....	71,100	6
Flint .... do....	36,365	1
Fuller's earth .... do....	11,492	
Glass sand .... do....	943,135	8
Graphite (crystalline) .... pounds..	3,936,824	1
Graphite (amorphous) .... short tons..	4,739	
Limestone for iron flux .... long tons..	12,139,248	5,
Magnesite .... short tons..	2,830	
Manganese ore .... long tons..	7,477	
Mica (sheet) .... pounds..	373,266	
Mica (scrap) .... short tons..	1,400	
Mineral waters .... gallons sold..	64,859,451	8,
Monazite .... pounds..	802,000	
Zircon .... do....	....	....
Precious stones	....	
Pumice stone .... short tons..	700	
Rutile .... pounds..	(b)	....
Talc and soapstone .... short tons..	26,854	
Uranium and vanadium .... do....	3,810	
Total value of nonmetallic mineral products	....	617,
Total value of metallic products	....	642,
Estimated value of mineral products unspecified	....	1,
Grand total	....	1,260,

a Included under pyrite.

b Included under estimated unspecified product

Mineral products of the United States for the calendar years 1880–1903—Continued.

Product.	1903. Quantity.	Value.
METALLIC.		
Pig iron, value at Philadelphia ......long tons..	18,009,252	$344,350,000
Silver, coining value ......troy ounces..	54,300,000	70,206,060
Gold, coining value ......do....	3,560,000	73,591,700
Copper, value at New York City ......pounds..	698,044,517	91,506,006
Lead, value at New York City ......short tons..	280,000	23,520,000
Zinc, value at New York City ......do....	159,219	16,717,995
Quicksilver, value at San Francisco ......flasks..	35,620	1,544,934
Aluminum, value at Pittsburg ......pounds..	7,500,000	2,284,900
Antimony, value at San Francisco ......short tons..	3,128	548,433
Nickel, value at Philadelphia ......pounds..	114,200	45,900
Tin ......do....	(a)	......
Platinum, value (crude) at San Francisco ......troy ounces..	110	b 2,080
Total value of metallic products	......	624,318,008
NONMETALLIC (SPOT VALUES).		
Bituminous coal ......short tons..	282,749,348	351,687,933
Pennsylvania anthracite ......long tons..	66,613,454	152,036,448
Natural gas	......	35,815,360
Petroleum ......barrels..	100,461,337	94,694,050
Brick clay	......	15,000,000
Cement ......barrels..	29,899,140	31,931,341
Stone	......	67,960,468
Corundum and emery ......short tons..	2,542	64,102
Crystalline quartz ......do....	8,938	76,908
Garnet for abrasive purposes ......do....	3,950	132,500
Grindstones	......	721,446
Infusorial earth and tripoli ......short tons..	9,219	76,273
Millstones	......	52,552
Oilstones, etc	......	366,857
Arsenious oxide ......short tons..	611	36,696
Borax (crude) ......do....	34,430	661,400
Bromine ......pounds..	598,500	167,580
Fluorspar ......short tons..	42,523	213,617
Gypsum ......do....	1,041,704	3,792,943
Lithium ......do....	1,155	23,425
Marls ......do....	34,211	22,521
Phosphate rock ......long tons..	1,581,576	5,319,294
Pyrite ......do.... / Sulphur ......do....	c 233,127	1,109,818
Salt ......barrels..	18,968,089	5,286,988
Barytes (crude) ......short tons..	50,397	152,150
Cobalt oxide ......pounds..	120,000	d 228,000
Mineral paints ......short tons..	62,122	646,222
Zinc white ......do....	62,962	4,801,718
Asbestos ......do....	887	16,760
Asphaltum ......do....	101,255	1,005,446
Bauxite ......long tons..	48,087	171,306
Chromic iron ore ......do....	150	2,250
Clay (all other than brick) ......short tons..	1,650,835	2,649,042
Feldspar ......do....	41,891	256,733
Fibrous talc ......do....	60,230	421,600
Flint ......do....	55,233	156,947
Fuller's earth ......do....	20,693	190,277
Glass sand ......do....	823,044	855,828
Graphite (crystalline) ......pounds..	4,538,155	225,554
Graphite (amorphous) ......short tons..	16,591	
Limestone for iron flux ......long tons..	12,029,719	5,423,732
Magnesite ......short tons..	3,744	10,595
Manganese ore ......long tons..	2,825	25,335
Mica (sheets) ......pounds..	90,100	17,128
Mica (scrap) ......short tons..	1,693	41,990
Mineral waters ......gallons sold..	51,242,757	9,041,078
Monazite ......pounds..	862,000	64,630
Zircon ......do....	3,000	570
Precious stones	......	321,400
Pumice stone ......short tons..	885	2,665
Rutile ......pounds..	......	......
Talc and soapstone ......short tons..	26,671	418,460
Uranium and vanadium ......do....	19	5,625
Total value of nonmetallic mineral products	......	794,403,561
Total value of metallic products	......	624,318,008
Estimated value of mineral products unspecified	......	1,000,000
Grand total	......	1,419,721,569

[a] No metallic tin; between 19 and 20 short tons of high-grade concentrates shipped to England from South Carolina.

[b] Not including $6,000 worth of platinum reported as contained in slimes from copper ore from the Rambler mine, Wyoming.

[c] Included under pyrite in 1901, 1902, and 1903.

[d] Not including value of 60 short tons of cobalt ore produced in Idaho.

IRON ORES.

By John Birkinbine.

PRODUCTION.

In the year ending December 31, 1903, the quantity of iron ore produced in the United States was 35,019,308 long tons. This is a decrease of 534,827 long tons, or about 1½ per cent, from the maximum of 35,554,135 long tons in 1902; but the quantity mined in 1903 is the second largest recorded, and is greater than the combined totals of Germany and Luxemburg and of the British Empire (the nearest competitors of the United States) in the year 1902. The data for 1903 for the countries named are not yet available, but the same comparison will probably prove true for this year also. The average iron content of the ore mined in the United States is also higher than that obtained in the two countries mentioned, and therefore the ore can produce a greater amount of pig iron.

The total yearly production of iron ore in the United States from the year 1889, when statistics were first collected by the United States Geological Survey, to the close of the year 1903, is as follows:

Production of iron ore in the United States, 1889–1903.

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 (minimum)	11,587,629	1902 (maximum)	35,554,135
1894	11,879,679	1903	35,019,308
1895	15,957,614	Total for fifteen years	305,521,317
1896	16,005,449	Average for fifteen years	20,368,088
1897	17,518,046		

The average of the annual production of iron ore mined in the United States in the last fifteen years exceeds the maximum output of any other country in any one year, the maximum production for Germany and Luxemburg being 18,964,294 metric tons in 1900,[a] and for Great Britain 18,031,957 long tons in 1882.

The iron ore obtained in 1903 came from 22 States and 2 Territories, Vermont and Montana reporting no ore mined in 1903, and Nevada being added to the list.

[a] Late data give the production of iron ore in Germany and Luxemburg in 1903 as 21,230,639 metric tons.

PRODUCTION BY VARIETIES OF IRON ORE.

As in previous reports the iron ore produced 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.

Some of the ore which is classed in this report as red hematite is designated locally as brown hematite, but such ores are mainly hydrated portions of deposits of red hematite and are therefore classed as red hematite.

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.

In 1903 the quantity of red hematite mined in the United States was 30,328,654 long tons, or 86.6 per cent of the total for the country, a decrease of 203,495 tons, or about 1 per cent, from the 1902 production of 30,532,149 long tons. Minnesota contributed over one-half of the red hematite ore, followed in order by Michigan and Alabama, each of these States with the exception of Michigan showing an increase over the 1902 totals.

The total quantity of brown hematite mined in 1902 (3,305,484 long tons) decreased in 1903 to 3,080,399 long tons, a loss of 225,085 tons, or 7 per cent. Alabama was the most important contributor of this class of ore, followed by Virginia and West Virginia, and Tennessee.

The production of magnetite in 1903 was 1,575,422 long tons, a decline of 113,438 long tons, or 7 per cent, from the 1902 total of 1,688,860 tons. The three principal States mining this class of ore are New Jersey, New York, and Pennsylvania, ranking in 1903 in the order named.

The carbonate ores, the least important class, show an increase, the 1903 total of 34,833 long tons being 7,191 tons, or 26 per cent, more than the quantity mined in 1902, 27,642 long tons. As in 1902 all of this class of ore was obtained in Ohio and Maryland.

The following table shows the quantities of the different classes of iron ore mined in the year 1903 by States, except where two or more States have been combined to preserve the confidential character of the reports. The different States are arranged according to their rank as producers.

Production of iron ore in the United States in 1903, by States and varieties.

[Long tons.]

State.	Red hematite.	Brown hematite.	Magnetite.	Carbonate.	Total.
Minnesota	15,371,396				15,371,396
Michigan	10,592,933		7,397		10,600,330
Alabama	2,779,691	905,269			3,684,960
Tennessee	371,189	481,515			852,704
Virginia and West Virginia	31,609	764,948	4,604		801,161
Wisconsin	646,042	29,011			675,053
Pennsylvania	15,420	202,542	426,637		644,599
New York	83,820	5,159	451,481		540,460
New Jersey			484,796		484,796
Georgia	124,648	318,804			443,452
Nevada, New Mexico, Utah, and Wyoming	235,599	13,800	142,843		392,242
Colorado	3,621	249,288			252,909
North Carolina		17,588	57,664		75,252
Missouri	49,359	14,021			63,380
Texas		34,050			34,050
Kentucky	23,327	8,900			32,227
Connecticut and Massachusetts		30,729			30,729
Ohio				29,688	29,688
Maryland		4,775		5,145	9,920
Total	30,328,654	3,080,399	1,575,422	34,833	35,019,308

The statistics of the production of iron ores in the United States in the last decade and a half have been collected annually by the United States Geological Survey, and a summary of the totals of the different classes of iron ore mined is presented in the table below, together with the grand totals for the entire period, and the percentage which the total for each class bears to that of the entire country.

Production of iron ores in the United States, by varieties, 1889–1903.

[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*
1903	30,328,654	3,080,399	1,575,422	34,833	35,019,308
Total	241,411,812	37,331,387	24,788,975	1,989,143	305,521,317
Percentages of totals for 15 years	79.0	12.2	8.1	0.7	100.00
Percentages of total for 1903	86.6	8.8	4.5	0.1	100.00

The year 1902 is credited with maximum quantities of both the red hematite and the brown hematite varieties; the year 1890 shows the greatest production of the magnetite, and the year 1889 of the carbonate.

The output of concentrated ore in the year 1903 was 259,469 long tons, most of which was magnetically separated, the remainder having been passed through jigs.

In 1903 there were also produced 73,264 tons of zinc residuum for use in the production of spiegeleisen and ferro-manganese.

LAKE SUPERIOR REGION.

This district stands preeminent as a producer of iron ore, its annual output exceeding that of any foreign country and the average character of the ore being excellent.

In the year 1903 there was obtained from the Mesabi and Vermilion ranges in Minnesota, the Marquette Range in Michigan, and the Menominee and Gogebic ranges in Michigan and Wisconsin, a total of 26,573,271 long tons of iron ore. Of this ore 51 per cent, or 13,452,812 long tons, was obtained from the Mesabi Range; 15 per cent, or 4,093,320 tons, was won from the Menominee; 14 per cent, or 3,686,214 tons, was mined on the Marquette Range; 13 per cent, or 3,422,341 tons, came from the Gogebic Range; and 7 per cent, or 1,918,584 tons, was credited to the Vermilion Range.

In addition to the above-named ranges in the United States, which by common consent compose the Lake Superior iron ore region, a sixth, the Michipicoten Range, was opened in Canada in the year 1900 but its product in 1903, 223,976 long tons, is not included in the abov data. The total production of the Michipicoten Range to the close o the year 1903 is only 815,152 long tons. The greater portion of thi ore has been sent to the United States, and is non-Bessemer i character.

The production of iron ore in the Lake Superior Region (not inclu ing the Michipicoten Range), from 1889 to 1903, inclusive, by range is as follows:

Production of Lake Superior iron ores, by ranges, 1889–1903.

[Maxima in italics.]

Range.	1889.	1890.	1891.	1892.	1893.
	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
Menominee	1,876,157	2,274,192	1,856,124	2,402,195	1,563,049
Gogebic	2,147,923	2,914,081	2,041,754	3,058,176	1,466,815
Vermilion	864,508	891,910	945,105	1,226,220	815,735
Mesabi				29,245	684,194
Total	7,519,614	8,944,031	7,621,465	9,564,388	6,594,620

Range.	1894.	1895.	1896.	1897.	1898.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Marquette	1,935,379	1,982,080	2,418,846	2,673,785	2,987,930
Menominee	1,255,255	1,794,970	1,763,235	1,767,220	2,275,661
Gogebic	1,523,451	2,625.475	2,100,398	2,163,088	2,552,205
Vermilion	1,055,229	1,027,103	1,200,907	1,381,278	1,125,538
Mesabi	1,913,234	2,839,350	3,082,973	4,220,151	4,837,971
Total	7,682,548	10,268,978	10,566,359	12,205,522	13,779,308

Range.	1899.	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Marquette	3,634,596	*3,945,068*	3,597,089	3,734,712	3,686,214
Menominee	3,281,422	3,680,738	3,697,408	*4,421,250*	4,093,320
Gogebic	2,725,648	3,104,033	3,041,869	*3,683,792*	3,422,341
Vermilion	1,643,984	1,675,949	1,805,996	*2,057,532*	1,918,584
Mesabi	6,517,305	8,158,450	9,303,541	13,080,118	*13,452,812*
Total	17,802,955	20,564,238	21,445,903	*26,977,404*	26,573,271

This table shows that until 1895 the Marquette Range, embracing the oldest developments, was the most prominent producer, except in the years 1890 and 1892, and that since 1895 it has either occupied second or third position. In late years the Menominee Range has alternately occupied second and third position, but it has never ranked first. The Gogebic Range took first place in 1890, and again in 1892; it then ranked second or third until 1898, inclusive; and subsequently it has occupied fourth place as a producer.

The most recently developed range, the Mesabi, took first rank as a producer in the fourth year of its history, 1895. This position it has steadily maintained until now its annual output is equal to that of the other four ranges combined.

All of the ranges except the Mesabi showed a falling off in production in the year 1903. The years of maximum production are: For the Marquette Range, 1900; for the Menominee, Gogebic, and Vermilion ranges, 1902; and for the Mesabi, 1903.

Cargo analyses of the Lake Superior iron ores as shipped i year 1903, together with some expected analyses for 1904 (furı through the courtesy of the Lake Superior Iron Ore Associatioı as follows:

Complete average cargo analyses of Lake Superior iron ores of season 1903.

GOGEBIC RANGE.

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

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition
	Per cent.	Per cent.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Ashland	60.39	0.0397	6.53	0.250	3.13	0.130	0.090	0.012	3.03
	53.9946	.03549	5.8384	.2235	2.7985	.1162	.0804	.0107	2.7091
Anvil[a]	61.625	.0495	6.05	.79	1.145	.335	.165	.0245	2.695
	53.20	.0427	5.22	.68	.988	.289	.14	.021	2.326
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
Argos[a]	59.00	.14	9.00						
	52.958	.12565	8.078						
Atlantic	63.2855	.0443	5.3451	.5276					
	56.6262	.03964	4.7827	.4721					
Aurora	62.8198	.0365	4.6234						
	55.8950	.03248	4.1137						
Best	55.90	.059	12.32	.90	1.219	.32	.45	.011	3.25
	49.73	.052	10.96	.80	1.084	.28	.40	.0097	2.89
Bonnie	51.80	.056	12.00	4.621	1.53	.05	.16	.015	5.33
	46.75	.0505	10.83	4.17	1.38	.045	.14	.0135	4.81
Brotherton[a]	62.00	.027	7.50	.57	.899	.21	.21	.003	1.19
	56.5192	.02461	6.837	.5196	.8195	.1914	.1914	.0027	1.084
Buckeye	59.96	.071	8.96	.41	1.98	.59	.67	.019	2.50
	52.5789	.06226	7.8570	.3595	1.7363	.5174	.5875	.0167	2.192
Cary	60.07	.078	6.95	.41	1.01	.20	.13	.006	4.92
	54.3213	.07054	6.2849	.3708	.9133	.1809	.1176	.0054	4.449
Cary Empire	57.86	.062	6.30	3.05	1.16	.25	.13	.006	5.26
	52.2534	.05599	5.6895	2.7545	1.0476	.2258	.1174	.0054	4.750
Chicago	56.0189	.0757	17.4557	.4011					
	55.7025	.07527	17.3570	.3988					
Colby	63.170	.036	5.100	.500	1.390	.246	.117	.006	3.420
	57.5416	.03279	4.6456	.4554	1.2662	.2241	.1066	.0055	3.115
Geneva	51.2745	.0577	11.4583	5.2216					
	46.0958	.05187	10.3010	4.6942					
Hildreth	54.63	.080	13.91	.59	2.45	.39	.46	.009	3.71
	47.4844	.06954	12.0906	.5128	2.1295	.3390	.3998	.0078	3.224
Iron Belt	59.91	.042	8.95	.40	1.56	.30	.40	.020	3.75
	52.4692	.03678	7.8384	.3503	1.3662	.2627	.3503	.0175	3.284
Ironton	62.800	.046	6.200	.780	1.520	.347	.258	.005	2.920
	56.5200	.04140	5.5800	.7020	1.3680	.3123	.2322	.0045	2.628
Ironton Manganese	56.200	.047	9.050	4.740	.600	.650	.480	.006	2.950
	50.4957	.04223	8.1314	4.2589	.5391	.5840	.4313	.0054	2.650
Jack Pot	61.10	.037							
	53.77	.033							
Lawrence	62.47	.054	4.64	.44	1.46	.11	.12	.008	3.96
	56.2605	.04863	4.1788	.3963	1.3149	.0991	.1081	.0072	3.566
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

[a] Expected analysis for the season of 1904.

Complete average cargo analyses of Lake Superior iron ores of season 1903—Continued.

GOGEBIC RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per cent.	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Melrose	60.88	0.043	5.90	0.65	1.39	0.08	0.08	0.019	4.70	
	54.348	.038	5.267	.58	1.24	.07	.07	.0169	4.195	10.728
Meteor a	55.910	.043	12.850	.390	1.150	.246	.172	.007	1.610	
	49.9835	.03844	11.4879	.3487	1.0281	.2199	.1538	.0063	1.4662	10.600
Mikado	58.00	.157	12.40	.40	1.03	.59	.12	.009	1.76	
	50.5760	.13690	10.8128	.3488	.8982	.5145	.1046	.0078	1.5347	12.80
Montreal	63.78	.044	3.68	.42	.94	.08	.06	.006	3.68	
	57.6571	.03978	3.3267	.3797	.8498	.0723	.0542	.0054	3.3267	9.60
Montrose	60.45	.076	6.56	.54	.72	.48	.21	.016	4.37	
	55.18	.069	5.988	.49	.657	.438	.19	.0146	3.989	8.717
New Era	57.50	.032	10.68	.64	1.92	.20	.18	.009	3.21	
	51.118	.028	9.49	.569	1.706	.177	.16	.008	2.85	11.099
New Era No. 2	56.92	.069	11.63	.66	1.05	.29	.19	.015	4.09	
	52.06	.063	10.638	.60	.96	.265	.17	.0137	3.74	8.53
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
Norden	62.6623	.0751	3.8108							
	55.5962	.06663	3.3811							11.2764
Norrie	63.1134	.0375	4.1580							
	56.2571	.03343	3.7063							10.8630
Ottawa	58.17	.061	5.18	3.02	1.37	.20	.25	.013	5.29	
	52.5391	.05509	4.6786	2.7277	1.2374	.1806	.2258	.0117	4.7779	9.08
Ottawa Manganese a	54.45	.068	4.36	6.80	1.18	.12	.09	.005	6.76	
	49.1030	.06132	3.9318	6.1322	1.0641	.1082	.0812	.0045	6.0962	9.82
Palms a	62.00	.045	5.27	.71	.91	.19	.18	.0115	4.24	
	54.975	.040	4.67	.63	.806	.168	.16	.010	3.76	11.33
Rand	62.4596	.0433	3.1654	1.9766						
	54.9059	.03806	2.7826	1.7376						12.0937
Rowe	56.25	.047	12.41	.90	1.51	.21	.19	.009	3.49	
	49.79	.0416	11.01	.796	1.336	.185	.168	.0079	3.089	11.48
Sunday Lake a	62.00	.026	7.50	.552	1.13	.07	.27	.006	1.02	
	56.6618	.02376	6.8542	.5044	1.0327	.0639	.2467	.0054	.9321	8.61
Taylor a	58.50	.055	9.18	.240	3.77	.250	.230	.014	2.41	
	52.15	.049	8.184	.214	3.361	.223	.205	.0125	2.148	10.85
Tilden	62.8658	.0511	3.8863	.8662						
	55.0885	.04478	3.4055	.7590						12.3712
Winona a	61.100	.043	9.180	.730	.890	.215	.085	.007	2.700	
	54.8067	.03857	8.2345	.6548	.7983	.1929	.0762	.0063	2.4219	10.500
Wisconsin a	50.00	.055	10.00	8.00						
	44.5000	.04895	8.9000	7.1200						11.00
Yale	62.0339	.036	5.42	.52	.73	.33	.25	.012	3.88	
	54.9341	.03188	4.7997	.4605	.6465	.2922	.2211	.0106	3.4359	11.115

MARQUETTE RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Abbottsford	62.8003	0.0334	7.9194							
	62.1279	.03304	7.8346							1.0707
Alford	64.2312	.0474	5.1326							
	56.4668	.04167	4.5122							12.0882
Angeline, hard	66.81	.011								
	63.33	.010								5.21

a Expected analysis for the season of 1904.

MARQUETTE RANGE—Continued.

Complete average cargo analyses of Lake Superior iron ores of season 1903—Con

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition
	Per cent.	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct*
Angeline, hematite	64.69	0.047							
	57.51	.042							
Angeline, south	62.24	.099							
	55.35	.088							
Beaufort [a]	51.74	.260	7.93	0.15	1.01	2.44	2.58	0.080	11.02
	47.4352	.23837	7.2702	.1375	.9260	2.2370	2.3653	.0733	10.103
Bedford	60.1813	.1509	7.9131						
	53.2258	.13346	6.9985						
Bell	38.4412	.0434	41.5627						
	37.9435	.04284	41.0244						
Beresford	62.7731	.1142	5.7594						
	62.2558	.11326	5.7119						
Beresford No. 1 [a]	63.50	.14	5.00						
	62.992	.13888	4.960						
Beresford No. 2 [a]	58.50	.14	11.50						
	58.032	.13888	11.408						
Bernhart	59.9002	.0603	7.9878						
	55.2330	.05560	7.3654						
Bessie	53.0833	.4760	10.6146						
	51.1969	.45908	10.2374						
Breitung Silicious [a]	40.00	.016	38.40	.95	2.30	.81	.11	.008	1.95
Buffalo	61.0552	.0943	5.4283						
	52.0839	.08044	4.6307						
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
Cambridge	60.15	.703	5.15	.57	1.10	2.73	.57	.036	1.90
	51.3741	.60043	4.3986	.4868	.9395	2.3316	.4868	.0307	1.622
Cameo	57.4046	.0969	7.1371						
	50.2290	.08479	6.2450						
Cameron [a]	59.70	.213	7.01	.22	2.91	.26	.39	.032	2.09
	52.54	.187	6.168	.19	2.56	.23	.34	.028	1.84
Castleford	55.5791	.0875	16.2241						
	55.0934	.08674	16.0823						
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	
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
Charlotte [a]	55.00	.105	12.26	.32	2.51	.49	.75	.016	2.40
	48.40	.092	10.788	.28	2.208	.43	.66	.014	2.11
Chatford	51.4045	.1220	20.9279						
	46.8828	.11127	19.0870						
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	1.655
Chester No. 2 [a]	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
Cliffs Shaft, Crushed	62.60	.102	4.29	.180	2.09	.750	.570	.016	.820
	62.0679	.10095	4.2535	.1784	2.0722	.7436	.5651	.0158	.813
Cliffs Shaft, Lump	63.40	.116	4.25	.190	2.23	.930	.700	.019	.900
	63.1590	.11555	4.2338	.1892	2.2215	.9264	.6973	.0189	.896
Comrade	55.20	.098	13.67	.120	2.96	.500	1.890	.017	1.000
	54.9847	.09761	13.6166	.1195	2.9484	.1980	1.8826	.0169	.996

[a] Expected analysis for the season of 1904.

Complete average cargo analyses of Lake Superior iron ores of season 1903—Continued.

MARQUETTE RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per cent.	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Foley No. 1 [a]	63.65	0.030	4.64	0.12	1.89	0.25	0.15	0.006	1.71	....
	57.285	.027	4.176	.108	1.701	.225	.135	.005	1.539	10.00
Foley No. 2 [a]	58.50	.027	13.98	.22	.73	.37	.002	.003	1.25	....
	....	....	....	....	....	....	....	....	....	....
Imperial Webster [a]	52.44	.256	13.49	.198	1.20	1.37	1.39	.011	7.38	....
	47.03	.229	12.10	.177	1.076	1.228	1.246	.009	6.62	10.32
Jackson, South	42.90	.073	29.26	2.81	1.49	.31	.29	.021	3.24	....
	39.2964	.06687	26.8022	2.5740	1.3648	.2840	.2656	.0192	2.9678	8.40
Lake	60.30	.110	5.64	.470	2.43	.430	.380	.011	3.45	....
	53.2690	.09717	4.9823	.4152	2.1466	.3798	.3357	.0097	3.0477	11.66
Lake Bessemer	63.44	.0389	5.55	.240	1.53	.230	.110	.009	1.30	....
	56.4679	.03461	4.9400	.2136	1.3618	.2047	.0979	.0080	1.1571	10.99
Lillie	59.455	.0706	6.16	.34	2.10	.41	.09	.013	3.34	....
	52.01	.0617	5.388	.297	1.837	.358	.078	.011	2.92	12.52
Mary [a]	60.00	.105	7.20	.32	2.51	.49	.75	.016	2.40	....
	52.80	.092	6.336	.28	2.208	.43	.66	.014	2.11	12.00
Michigamme	60.70	.092	10.03	.180	2.02	.700	.820	.020	....	....
	60.3358	.09144	9.698	.1789	2.0078	.6958	.8150	.0198	....	.60
Moore [a]	36.78	.046	43.09	....	....	....	....	....	....	....
	35.861	.04485	42.013	....	....	....	....	....	....	2.50
Negaunee Bessemer	60.30	.057	7.25	.35	2.77	1.00	.52	.020	1.90	....
	54.1976	.05123	6.5163	.3145	2.4896	.8988	.4673	.0179	1.7077	10.12
Negaunee non-Bessemer	57.61	.104	9.23	....	....	....	....	....	....	....
	51.7914	.09350	8.2978	....	....	....	....	....	....	10.10
Norfolk Bessemer, 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	....
	52.7688	.04606	1.9264	.3601	1.1475	.8794	.7789	.0175	1.3401	16.24
Princeton No. 2	61.11	.157	6.57	.497	1.576	.73	.66	.029	2.01	....
	51.0207	.13107	5.4852	.4149	1.3158	.6094	.5510	.0242	1.6781	16.51
Republic Crushed [a]	65.85	.047	....	....	....	....	....	....	....	....
	65.356	.0466	....	....	....	....	....	....	....	.75
Republic Kingston [a]	62.62	.045	7.21	.12	1.42	.42	.30	.027	.31	....
	61.94	.0445	7.132	.118	1.404	.415	.296	.0267	.306	1.08
Republic Specular [a]	67.77	.050	....	....	....	....	....	....	....	....
	67.004	.0494	....	....	....	....	....	....	....	1.13
Richmond	44.00	.056	33.45	.18	1.41	.24	.17	.006	2.16	....
	43.159	.0549	32.81	.176	1.38	.235	.166	.0058	2.118	1.91
Rose	59.08	.146	6.41	.32	2.45	.50	.18	.029	2.16	....
	53.17	.131	5.769	.297	2.20	.45	.16	.026	1.94	10.00
Salisbury	60.30	.095	6.71	.250	2.90	.500	.800	.010	1.95	....
	53.2810	.08394	5.9289	.2209	2.6684	.4418	.7069	.0088	1.7230	11.64
Scotch	61.70	.134	6.70	.120	2.60	.450	.560	.014	.350	....
	61.2125	.13294	6.6470	.1190	2.5794	.4464	.5555	.0138	.3472	.79
Sheffield	60.98	.038	....	....	....	....	....	....	....	....
	58.08	.036	....	....	....	....	....	....	....	4.75
Star West [a]	44.20	.046	35.20	.060	.648	.527	.134	.004	2.16	....
	43.6077	.04538	34.7283	.0592	.6393	.5199	.1322	.0039	2.1311	1.34
Tilden Silica	41.50	.040	37.25	.270	.850	.430	.110	.009	1.17	....
	40.9439	.03946	36.7508	.2664	.8386	.4242	.1085	.0088	1.1543	1.34

[a] Expected analysis for the season of 1904.

Complete average cargo analyses of Lake Superior iron ores of season 1903—Conti

MENOMINEE RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.
	Per cent.	Per cent.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Armenia	56.400	0.243	10.000	0.220	2.400	1.500	1.650	0.007	1.470
	50.6190	.21809	8.9750	.1974	2.1540	1.3462	1.4809	.0063	1.3193
Ajax	54.7272	.0629	10.3939	......	......	......	......	......	......
	51.0137	.05863	9.6886	......	......	......	......	......	......
Baltic	58.24	.550	4.41	.26	3.22	.89	.83	.043	5.94
	53.3245	.50358	4.0378	.2381	2.9482	.8149	.7599	.0394	5.4387
Bangor [a]	58.00	.30	9.00	......	......	......	......	......	......
	52.200	.2700	8.100	......	......	......	......	......	......
Barton	58.4425	.4613	4.7917	......	......	......	......	......	......
	54.5590	.43065	4.4733	......	......	......	......	......	......
Basic	54.090	.289	6.240	4.150	1.260	1.450	2.600	.008	3.400
	49.6222	.26513	5.7246	3.8072	1.1559	1.3302	2.3852	.0073	3.119
Bristol	55.66	.680	4.45	1.18	2.32	2.49	1.07	.008	6.98
	51.2406	.62601	4.0967	1.0868	2.1358	2.2923	.9850	.0074	6.425
Brunswick	55.6102	.5410	6.3689	......	......	......	......	......	......
	49.4791	.48135	5.6667	......	......	......	......	......	......
Chapin	59.7686	.0656	6.2752	......	......	......	......	......	......
	55.7286	.06117	5.8510	......	......	......	......	......	......
Clearfield	59.2763	.1328	5.5490	......	......	......	......	......	......
	51.8355	.11613	4.8525	......	......	......	......	......	......
Clifford	40.70	.015	38.56	.10	.82	.32	.36	.013	1.20
	39.6255	.01460	37.5420	.0974	.7983	.3116	.3505	.0127	1.168
Crystal Falls	58.100	.684	4.500	.240	1.860	2.720	1.270	.007	2.900
	52.7548	.62107	4.0860	.2179	1.6889	2.4698	1.1532	.0064	2.633
Davidson [a]	55.75	.158	7.40	.15	3.46	1.40	2.60	.210	4.75
	49.8963	.14141	6.6230	.1842	3.0967	1.2530	2.3270	.1879	4.251
Davy	40.82	.029	36.05	.15	.82	.99	1.07	.012	2.10
	40.199	.0285	35.50	.147	.807	.97	1.05	.0118	2.068
Florence	55.40	.283	5.70	.23	3.74	1.90	2.43	.083	4.80
	50.36	.257	5.18	.209	3.399	1.727	2.209	.075	4.36
Forest [a]	61.15	.028	6.25	......	......	......	......	......	......
	......	......	......	......	......	......	......	......	......
Genesee	59.720	.747	5.200	.460	1.570	2.230	1.320	.008	2.860
	54.3810	.68022	4.7351	.4189	1.4296	2.0306	1.2020	.0073	2.604
Granada	60.0254	.0612	6.0908	......	......	......	......	......	......
	55.565	.05665	5.6382	......	......	......	......	......	......
Gray	44.1640	.0372	24.2807	......	......	......	......	......	......
	43.8401	.03693	24.1026	......	......	......	......	......	......
Great Western	58.100	.305	6.600	.980	1.980	1.210	2.040	.008	2.950
	53.2428	.27950	6.0482	.8981	1.8145	1.1088	1.8695	.0073	2.703
Groveland [a]	51.300	.046	11.220	1.100	2.490	3.510	4.620	.008	5.290
	49.2224	.04414	10.7656	1.0555	2.3892	3.3678	4.4329	.0077	5.075
Hemlock	55.75	.210	5.87	.41	3.08	3.10	2.41	.011	4.63
	52.9458	.19944	5.5747	.3894	2.9251	2.9441	2.2888	.0104	4.397
Hiawatha [a]	56.00	.252	7.28	.60	2.52	.28	.21	.019	7.65
	52.0968	.2344	6.7725	.5581	2.3443	.2604	.1953	.0176	7.116
Hilltop [a]	51.57	.419	11.65	......	......	......	......	......	......
	......	......	......	......	......	......	......	......	......
Hope	59.4928	.2620	8.7978	......	......	......	......	......	......
	50.9882	.22455	7.5401	......	......	......	......	......	......
Kimball [a]	55.700	.660	6.300	.210	1.600	2.500	1.900	.008	3.100
	51.1326	.60588	5.7834	.1928	1.4688	2.2950	1.7442	.0073	2.845

[a] Expected analysis for the season of 1904.

Complete average cargo analyses of Lake Superior iron ores of season 1903—Continued.

MENOMINEE RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per cent.	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Lamont[a]	56.350	0.650	7.500	0.460	1.510	2.340	1.280	0.008	2.100	....
	51.3349	.59215	6.8325	.4191	1.3756	2.1317	1.1661	.0073	1.9131	8.900
Lerida	59.035	.0828	6.9622	....	....	....	....	....	....	....
	54.735	.07677	6.4549	....	....	....	....	....	....	7.2867
Lincoln	57.200	.336	7.740	.640	2.170	1.430	1.860	.008	2.690	....
	52.1664	.30643	7.0589	.5837	1.9790	1.3042	1.6963	.0073	2.4533	8.800
Loretto[a]	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	52.73	.566	4.45	3.18	2.98	1.70	1.37	.025	7.12	....
	48.5063	.52066	4.0986	2.9258	2.7413	1.5638	1.2608	.0230	6.5497	8.01
Manganate No. 2	50.48	.575	4.62	4.85	2.95	2.12	1.22	.026	7.65	....
	46.6031	.53084	4.2652	4.4775	2.7234	1.9572	1.1263	.0240	7.0625	7.68
Michigan No. 1[a]	59.00	.325	5.25	....	....	....	....	....	....	....
	53.985	.2974	4.804	....	....	....	....	....	....	8.50
Michigan No. 2[a]	50.00	.225	7.25	....	....	....	....	....	....	....
	46.750	.2104	6.779	....	....	....	....	....	....	6.50
Millie	60.40	.026	3.82	.21	.79	1.91	1.87	.017	4.30	....
	57.37	.0247	3.628	.199	.75	1.81	1.776	.016	4.08	5.01
Paint River[a]	56.300	.640	6.900	.480	2.900	1.540	1.100	.009	2.800	....
	51.2330	.58240	6.2790	.4368	2.6390	1.4014	1.0010	.0082	2.5480	9.000
Pewabic	63.70	.010	5.00	.14	1.06	.37	1.33	.004	1.03	....
	58.0434	.00911	4.5560	.1276	.9659	.3371	1.2119	.0036	.9385	8.88
Pewabic Genoa	42.00	.011	34.70	.09	1.62	.62	1.61	.013	1.21	....
	....	....	....	....	....	....	....	....	....	....
Quinnesec	44.270	.027	35.200	.130	1.050	.462	.672	.006	1.850	....
	43.2341	.02637	34.3763	.1270	1.0254	.4512	.6563	.0059	1.8067	2.340
Rosen	57.95	.314	4.46	.32	2.51	1.12	1.30	.056	4.58	....
	53.146	.2879	4.09	.29	2.30	1.027	1.19	.051	4.20	8.29
Russell	54.85	.063	9.58	.28	2.76	1.45	3.45	.027	4.00	....
	50.73	.058	8.86	.259	2.55	1.34	3.19	.0249	3.699	7.509
Tobin	59.870	.780	4.400	.550	1.080	2.250	.890	.008	2.180	....
	54.6495	.71198	4.0163	.5020	.9858	2.0538	.8124	.0073	1.9899	8.720
Toledo	54.00	.009	17.21	.11	1.55	.68	1.61	.005	1.43	....
	48.9078	.00815	15.5871	.0996	1.4038	.6159	1.4582	.0045	1.2952	9.43
Tyrone[a]	58.48	.050	8.78	.13	1.10	1.14	1.88	.002	1.87	....
	54.2811	.04640	8.1496	.1207	1.0210	1.0581	1.7450	.0019	1.7357	7.18
Vivian	41.00	.013	35.77	.20	1.94	.59	.92	.014	1.90	....
	39.3682	.01248	34.3464	.1920	1.8628	.5665	.8834	.0134	1.8244	3.98
Walpole	58.67	.102	8.51	.15	1.50	1.18	2.37	.007	2.06	....
	54.6570	.09502	7.9279	.1397	1.3974	1.0993	2.2079	.0065	1.9191	6.84

MESABI RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Adams	61.0446	0.0362	4.5891	0.5687	....	....	....	....	....	....
	54.6627	.03241	4.1093	.5092	....	....	....	....	....	10.4545
Adams, No. 2	57.7150	.0757	5.2713	.7016	....	....	....	....	....	....
	49.1548	.06447	4.4894	.5975	....	....	....	....	....	14.8332
Admiral[a]	63.800	.027	4.900	.300	0.620	0.230	0.180	0.006	2.140	....
	58.8236	.02489	4.5178	.2766	.5716	.2121	.1660	.0055	1.9731	7.800
Agnew	59.93	.056	5.24	.87	2.34	.16	.13	....	4.82	....
	50.52	.046	4.41	.73	1.97	.14	.11	....	4.07	15.66

[a] Expected analysis for the season of 1904.

Complete average cargo analyses of Lake Superior iron ores of season 1903—Conti

MESABI RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.
	Per cent.	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Albany [a]	60.00	0.077	3.74	0.75	1.80	0.30	0.19	0.008	7.04
	53.0400	.06807	3.3062	.6630	1.5912	.2652	.1680	.0071	6.2234
Beaver	63.20	.079	2.39	.28	1.39	.23	.15	.016	4.45
	56.60	.0707	2.14	.25	1.24	.206	.13	.014	3.985
Bessemer	60.50	.038							
	55.660	.03496							
Biwabik	61.93	.044	4.54	.49	1.37	.32	.08	.010	4.47
	56.5111	.04015	4.1427	.4471	1.2501	.2920	.0730	.0091	4.0788
Butler [a]	62.00	.055	4.50	.49	1.20	.32	.08	.010	4.47
	57.0400	.05060	4.1400	.4508	1.1040	.2944	.0736	.0092	4.1124
Cass [a]	59.00	.040	9.32	.939	1.765	.24	.05	.014	5.20
	53.6900	.03640	8.4812	.8544	1.6061	.2184	.0455	.0127	4.7320
Chisholm	61.2441	.0457	4.9473	.7585					
	55.0483	.04107	4.4468	.6818					
Clairton [a]	60.00	.059							
	54.00	.0531							
Clark	62.7307	.0321	3.5830	.6361					
	56.7237	.02902	3.2399	.5752					
Commodore [a]	63.100	.039	4.150	.200	1.210	.240	.060	.004	3.400
	57.2317	.03537	3.7640	.1814	1.0975	.2177	.0544	.0036	3.083
Corsica	57.00	.044	9.05	.98	1.27	.19	.18	.009	6.22
	50.0745	.03865	7.9504	.8609	1.1157	.1669	.1581	.0079	5.464
Crosby [a]	58.00	.040							
	51.91	.0358							
Croxton	58.87	.057	6.38	.718	1.446	.22	.16	.010	6.04
	52.923	.05124	5.735	.6455	1.2999	.198	.144	.0090	5.430
Cyprus	60.25	.064	3.78	.98	1.77	.29	.22	.009	6.35
	53.1646	.05647	3.3355	.8648	1.5618	.2559	.1941	.0079	5.603
Duluth	60.7764	.0453	5.0045						
	54.6149	.04071	4.4972						
Elba	61.67	.036	4.13	.96	1.03	.20	.11	.008	4.70
	56.2924	.03286	3.7699	.8763	.9402	.1826	.1004	.0073	4.290
Fayal	63.0445	.0328	3.9870						
	57.6279	.02998	3.6445						
Franklin	62.00	.037							
	58.038	.03464							
Genoa	62.6554	.0295	4.1599						
	57.0477	.02686	3.7876						
Grant	60.84	.073	5.05						
	52.64	.063	4.37						
Hawkins	56.89	.047	11.59	.27	2.13	.19	.14		3.95
	50.15	.0406	10.19	.22	1.88	.17	.12		3.50
Higgins [a]	62.00	.035	8.00						
	56.7300	.03202	7.3200						
Holland [a]	61.00	.040	5.27	.41	.92	.29	.11	.012	3.37
	54.9000	.03600	4.7430	.3690	.8280	.261	.099	.0108	3.033
Island	61.5846	.0610	3.8914						
	54.8448	.05432	3.4655						
Jordan	62.10	.057	4.150	.625	.628	.153	.154	.006	3.584
	55.7658	.05119	3.7267	.5612	.5639	.1374	.1383	.0054	3.218
Juniata	61.1178	.0490	6.1829	.2879	2.3817				
	52.9020	.04241	5.3518	.2492	2.0615				

[a] Expected analysis for the season of 1904.

Complete average cargo analyses of Lake Superior iron ores of season 1903—Continued.

MESABI RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per cent.	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Kanawha	53.691	0.0826								
	46.972	.07226								12.514
Kinney *a*	58.50	.09	5.00	0.60	2.50	0.70	0.40			
	52.06	.08	4.45	.53	2.22	.62	.36			11.00
La Rue *a*	60.00	.045	7.87	.423	.958	.16	.03	0.012	2.72	
	55.2000	.04140	7.2404	.3891	.8813	.1472	.0276	.0110	2.5024	8.00
Leetonia *a*	61.00	.061	3.81	.975	.924	.05	.04	.009	6.93	
	54.9000	.05490	3.4290	.8775	.8316	.0450	.0360	.0081	6.2370	10.00
Leonard *a*	59.95	.071	3.24	.38	1.67	.24	.12	.008	8.50	
	53.96	.064	2.92	.34	1.50	.22	.11	.007	7.65	10.00
Lincoln	58.41	.089	10.22							
	52.79	.085	9.24							9.63
Longyear	57.675	.0621								
	50.828	.05473								11.872
Mahoning	65.20	.047	1.90	.28	1.06	.15	.05	.019	3.20	
	58.777	.042	1.71	.25	.955	.135	.045	.017	2.88	9.85
Malta	62.63	.027	5.60	.70	.80	.28	.18	.012	2.45	
	56.9808	.02456	5.0949	.6369	.7278	.2547	.1638	.0109	2.2290	9.02
Minorca *a*	60.00	.035	8.62	.64	1.76	.29	.18	.008	2.53	
	55.1840	.03216	7.9209	.5881	1.6173	.2665	.1654	.0074	2.3248	8.11
Morris *a*	60.00	.060								
Morrow *a*	60.00	.061	7.52	.810	1.391	.22	.05	.016	4.94	
	54.6000	.05551	6.8432	.7371	1.2658	.2002	.0455	.0145	4.4954	9.00
Mountain	63.4528	.0429	4.3351	.2093	1.9757					
	54.9330	.03713	3.7530	.1812	1.7104					13.4270
Oliver	62.3949	.0491	5.1103	.2417	2.1360					
	54.1228	.04259	4.4328	.2096	1.8528					13.2577
Pearce *a*	60.00	.045	7.00	1.10	1.50	.18	.30	.020	5.62	
	54.0000	.04050	6.3000	.9900	1.3500	.1620	.2700	.0180	5.0580	10.00
Penobscot	59.8843	.0540	6.6604							
	54.3963	.04905	6.0500							9.1644
Pillsbury	62.5452	.0412	4.1964							
	56.1166	.03696	3.7651							10.2784
Preble	60.3268	.0503	6.6447	.3198	2.3682					
	52.5822	.04384	5.7917	.2787	2.0642					12.8377
Sauntry *a*	60.50	.065	4.75							
	54.4500	.05850	4.2750							10.00
Sharon	57.4201	.0599	7.6562							
	50.2267	.05240	6.6971							12.5276
Shenango *a*	64.00	.040								
	56.32	.0352								12.00
Shilling *a*	62.18	.063	3.81	.65	1.36	.10	.05	.010	6.09	
	56.0000	.05674	3.4316	.5854	1.2249	.0900	.0450	.0090	5.4852	9.93
Sparta *a*	62.53	.028	6.44	.52	.89	.17	.13	.010	2.25	
	57.3463	.02568	5.9061	.4769	.8162	.1559	.1192	.0092	2.0635	8.29
Spruce No. 2	58.4383	.0690	4.3472	.6192						
	48.4858	.05724	3.6068	.5137						17.0307
St. Clair	57.9121	.0776	6.8596							
	51.5085	.06902	6.1011							11.0574

a Expected analysis for the season of 1904.

Complete average cargo analyses of Lake Superior iron ores of season 1903—Conti

MESABI RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	
	Per cent.	*Per cent.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	
Stephens	59.4478	0.0621	4.5467	0.4409	2.6804	......	......	......	......	
	50.8305	.05310	3.8876	.3770	2.2919	......	......	......	......	
Stevenson	64.100	.038	3.600	.350	.760	0.315	0.148	0.004	1.420	
	58.8118	.03486	3.3090	.3211	.6973	.2890	.1358	.0037	1.3028	
Thompson	62.4480	.0363	3.4253	.6451	......	......	......	......	......	
	56.1025	.03261	3.0772	.5795	......	......	......	......	......	
Top Brown [a]	61.00	.037	7.34	.59	1.11	.29	.21	.010	2.86	
	54.9061	.03330	6.1667	.5811	.9991	.2610	.1890	.0090	2.5743	
Troy [a]	55.00	.035	10.68	.69	3.17	.25	.74	.138	5.43	
	48.4000	.03080	9.3984	.6072	2.7896	.2200	.6512	.1214	4.7784	1
Tubal	59.6991	.0633	5.4679	......	......	......	......	......	......	
	51.6698	.05479	4.7325	......	......	......	......	......	......	1
Union	59.02	.052	......	......	......	......	......	......	......	
	53.196	.0469	......	......	......	......	......	......	......	
Victoria	61.00	.051	......	......	......	......	......	......	......	
	56.181	.04697	......	......	......	......	......	......	......	
Virginia Mines [a]	62.50	.075	3.00	......	......	......	......	......	......	
	56.2500	.06750	2.7000	......	......	......	......	......	......	10
Wallace	62.950	.051	3.670	.392	.858	.215	.157	.006	2.100	...
	57.5552	.04663	3.3555	.3584	.7845	.1966	.1435	.0055	1.9200	8
VERMILION RANGE.										
Chandler	63.9292	0.0444	4.7339	......	......	......	......	......	......	......
	60.6527	.04212	4.4913	......	......	......	......	......	......	5.
Jura	62.3289	.0684	4.0973	......	......	......	......	......	......	......
	58.5416	.06424	3.8483	......	......	......	......	......	......	6.
Pioneer	63.0831	.0359	5.1426	......	......	......	......	......	......	......
	59.645	.03395	4.8626	......	......	......	......	......	......	5.
Pilot	67.0021	.0296	2.1245	......	......	......	......	......	......	......
	65.50	.02894	2.0769	......	......	......	......	......	......	2.
Red Lake	61.2353	.1113	9.1355	......	......	......	......	......	......	......
	60.7834	.11039	9.0606	......	......	......	......	......	......	.
Savoy	64.0700	.0538	3.5972	......	......	......	......	......	......	......
	60.3768	.05070	3.3899	......	......	......	......	......	......	5.7
Sibley	65.0337	.0323	3.4502	......	......	......	......	......	......	......
	61.5926	.03059	3.2676	......	......	......	......	......	......	5.2
Soudan Vermilion Lump	66.7906	.1015	3.2170	......	......	......	......	......	......	......
	66.5053	.10107	3.2038	......	......	......	......	......	......	.4
Soudan Silicious	58.9729	.0509	14.2068	......	......	......	......	......	......	......
	58.4490	.05045	14.0806	......	......	......	......	......	......	.8
Zenith	65.5901	.0386	3.4910	......	......	......	......	......	......	......
	61.9303	.03645	3.2962	......	......	......	......	......	......	5.57
MICHIPICOTEN RANGE.										
Helen	57.65	0.094	7.40	0.23	1.48	0.12	0.10	0.177	7.64	......
	54.06	.088	6.939	.215	1.388	.11	.09	.166	7.16	6.22

[a] Expected analysis for the season of 1904.

DISTRIBUTION OF IRON-ORE PRODUCTION IN 1903, BY STATES.

Minnesota.—The iron ore mined in this State in 1903 (15,371,396 long tons), all of the red hematite variety, came from the Mesabi and Vermilion ranges in the Lake Superior region. The State shows an increase of 233,746 long tons, or about 2 per cent, over the 1902 total of 15,137,650 tons. The shipments, however, were less in 1903 than in 1902, and the stocks of ore on hand at the mines increased.

Minnesota has a unique record as a producer of iron ore. Until the year 1884, when the Vermilion Range was first exploited in what was then a wilderness, no ore was mined in the State, but in that year the initial production of 62,122 long tons was obtained. The output has increased rapidly year by year. Mining on the Mesabi Range began in 1892, since which time it has made marvelous progress, the Range attaining the preeminence in the Lake Superior district in the year 1895 which it has since held. The State, as a whole, shows a yearly increase in the iron-ore production from the time iron ore was first obtained in 1884 to the close of the year 1903, a period of twenty years. No other State in the Union has such a record. In addition, the known reserves of iron ore on the Mesabi Range are greater than on any other of the Lake Superior ranges, and explorations are being prosecuted on both the Mesabi and the Vermilion ranges.

It is hard to understand from figures what is represented by the 15,371,396 long tons of iron ore mined in Minnesota in 1903. In this connection a comparison with some of the more prominent of the older producers may be appropriate. The Cornwall Ore Hills in Pennsylvania were first opened in 1740, and since that period they have produced to the close of 1903 over 18,000,000 tons of ore. The Lake Champlain district since its initial exploitation in 1804 is reported to have contributed over 20,000,000 tons. The magnetite deposits of New Jersey were probably first worked about the year 1710, and since that time the output has reached a total of nearly 22,000,000 long tons. Thus it will be seen that Minnesota in the single year 1903 produced, in round numbers, three-fourths of the total output for nearly two centuries of either of these three celebrated regions or, say, one-fourth of the combined output of all three.

Michigan.—Michigan holds second rank as a producer of iron ore with a total of 10,600,330 long tons, a decrease of 534,885 tons, or nearly 5 per cent, from the 1902 output of 11,135,215 tons. Of the 1903 total, 10,592,933 tons were red hematite, giving it second rank in this class of ore, and the remainder 7,397 tons was of the magnetite variety. As in the case of Minnesota there was an increase in Michigan in the stocks of ore on hand at the mines. All of the iron ore obtained comes from the Marquette, Menominee, and Gogebic ranges, which are treated collectively under the head of the Lake Superior region.

The production of 1903 shows a decline from the maximum output of 1902, but with that exception it is the largest quantity mined in any one year in the history of the State.

Alabama.—This State occupies third position as a producer of iron ore, with a total of 3,684,960 long tons, of which 2,779,691 tons were of the red hematite variety, and 905,269 tons were brown hematite. The total production in 1903 was 110,486 tons, or 3 per cent greater than in 1902 when 3,574,474 tons were obtained. All of this increase was in the red hematite ores, the brown hematites showing a decrease. The State occupied third position as a producer of red hematites, and first of brown hematites.

Tennessee.—This State, which ranked fifth in 1902 with a total of 874,542 long tons, showed a falling off of 21,838 long tons, or 3.5 per cent in 1903, when 852,704 tons were mined; but Tennessee advanced to fourth place owing to the decrease in the combined output of Virginia and West Virginia. The State contributed 481,515 tons of brown hematite ore, and 371,189 tons of red hematite, occupying in these classes third and fifth rank, respectively.

Virginia and West Virginia.—These two States (which have been combined in order not to disclose individual statistics) in the year 1903 supplied 801,161 long tons of iron ore, a decline of 186,797 tons, or 19 per cent from the 1902 total of 987,958 tons. Of this quantity 764,948 tons were brown hematite, 31,609 tons red hematite, and 4,604 tons magnetite, giving the States second, tenth, and seventh place, respectively, in these classes of ores.

Wisconsin.—This State produced 675,053 long tons of iron ore in the year 1903, a decline of 108,943 long tons, or 14 per cent from the 1902 total of 783,996 tons. Of the total production 646,042 long tons were of the red hematite variety, in which class the State occupied fourth place, and the remainder, 29,011 long tons, was brown hematite. The State ranked sixth as an iron-ore producer.

This year witnessed the initial production of iron ore in the new Baraboo Iron Range, near the town of Freedom in southern Wisconsin. In 1903 Mr. S. Weidman made an investigation for the Wisconsin geological and natural history survey of the occurrence of iron ore in the Baraboo Range, which is summarized as follows in Bulletin No. 225 of the United States Geological Survey:[a]

A pre-Cambrian quartzite formation, having an estimated thickness of 3,000 to 5,000 feet, forms an east-west synclinorium about 20 miles long and ranging in width from 2 miles on the east to 10 or 12 miles on the west, resting on a basement of igneous rock. The upturned north and south edges of the quartzite form, respectively, the north and the south ranges of the Baraboo bluffs, standing 700 to 800 feet above the surrounding country and above the intervening valley. This valley is occupied by formations younger than and conformable with the quartzite. Mr. Weidman has named these

[a] Contributions to Economic Geology, 1903: Bull. U. S. Geol. Survey No. 225, 1904, pp. 218–220.

formations the Seeley slate and the Freedom formation. The Seeley slate has an estimated thickness of 500 to 800 feet, and above this is the Freedom formation, mainly dolomite, which has a thickness estimated to be at least 800 feet, and which bears the iron-ore deposits in its lower horizon.

Flat-lying Paleozoic sediments, unconformably overlying the pre-Cambrian rocks, occupy the surrounding area and partly fill the valley. Paleozoic rocks range from Upper Cambrian (Potsdam) in the valley bottom to the Ordovician (Trenton) on the upper portions of the quartzite ranges. The Potsdam sandstone has a thickness ranging from a few feet to a maximum of about 570 feet in the valley. Glacial drift is abundant over the quartzite ranges and in the valleys in the eastern half of the district, but occurs only in the valleys in the western half.

The iron ore occurs in the lower horizons of the Freedom formation and is mainly a bessemer hematite, with soft and earthy, hard and black, and banded siliceous phases. A very small amount of hydrated hematite or limonite is also present. The rocks immediately associated with the ore and into which the ore grades are dolomite, cherty ferruginous dolomite, ferruginous chert, ferruginous slate, and ferruginous dolomitic slate—in fact, all possible gradations and mixtures of the minerals dolomite, hematite, quartz, and such argillaceous minerals as kaolin and chlorite. In the ferruginous rocks associated with the iron ore, the iron occurs as hematite and also in the form of carbonate, isomorphous with carbonate of calcium, magnesium, and manganese, in the form of ferrodolomite and manganic-ferro-dolomite, and as silicates combined with various proportions of alumina, lime, magnesia, and manganese, as chlorite and mica, and also very probably to a small extent as iron phosphate.

The ore deposits thus far found are all in the valley between the quartzite ranges, and because of the structure of the pre-Cambrian series it is hardly possible that ore deposits will be found elsewhere than in this valley.

The iron ore is a stratified formation and is conformable with the associated stratified rocks, both below and above. The ore bodies, therefore, have the dip and strike of the associated rocks, and are found dipping at various angles from nearly horizontal to nearly vertical.

At the Illinois mine, 3 miles southwest of North Freedom, and on the south limb of the syncline, the ore deposit has a thickness of 30 to 35 feet, and bears an average of 54 to 58 per cent metallic iron. The dip of the ore body and adjacent formation is about 50° N. Between the ore and the underlying Seeley slate are 100 feet of alternating beds and thin seams of iron ore with a considerable thickness of dolomite and ferruginous dolomite, ferruginous chert, and ferruginous slate. Between the ore deposit and the overlying dolomite are alternating strata of similar character grading up into the nearly pure dolomite. North of the Illinois mine a thickness of 600 feet of dolomite is known to occur.

Underground exploration seems to show that the conditions and character of the rock existing at the Illinois mine prevail generally, as should be expected, throughout the valley wherever the iron formation and overlying rocks have not been eroded by the subsequent pre-Potsdam erosion. In general, there appears to be a highly ferruginous horizon near the base of the dolomitic formation, having a variable thickness, probably ranging from 400 to 500 feet. This ferruginous horizon bears one or more deposits of iron ore separated by intervening strata of associated ferruginous rock. In one of the drill holes in the west end of the district nearly 200 feet of iron ore and paint rock were penetrated immediately beneath the unconformable Potsdam sandstone, the average content of iron for this distance being about 45 per cent.

The iron ore is believed by Weidman to be mainly a product of metamorphism of what was originally a deposit of nearly pure ferric hydrate, deposited in shallow lagoons and protected bays and formed in a manner similar to bog and lake ore at the present day, through chemical and organic processes acting upon and within shallow waters unusually rich in iron. The evidence of shallow water, and not deep sea, in which the iron was originally deposited, is furnished by the numerous sun cracks in the ferruginous carbonaceous slate immediately associated with the ore strata and the presence of carbonaceous matter in the iron ore and associated rocks. The process of metamorphism, it is believed, has been mainly that of dehydration of the original ferric hydrate, analagous to the partial dehydration of the originally hydrated silicates, chlorite, and kaolin of the underlying Seeley slate.

These deposits of Bessemer ore, within convenient railroad haul of the blast furnaces at Chicago, Ill., may prove an important adjunct to the ore supply of these furnaces.

Pennsylvania.—This State contributed 644,599 long tons of iron ore in the year 1903, being a decline of 178,333 long tons, or 22 per cent, from the 1902 total of 822,932 long tons. Three classes of ore were mined in 1903; 426,637 tons were of the magnetite variety, 202,542 tons brown hematite, and 15,420 tons red hematite, giving the State third, sixth, and twelfth place, respectively, in these classes of iron ore.

This decline is due almost entirely to the diminished output of one of the large mines, the Cornwall Ore Hills, to which Pennsylvania was indebted for its position as a prominent producer for a number of years.

New York.—In the year 1903 New York mined 540,460 long tons of iron ore, a decrease of 14,861 tons, or 3 per cent, from the 1902 total of 555,321 tons. Of this quantity 451,481 tons were of the magnetite variety, 83,820 tons were red hematite, and 5,159 tons brown hematite ore, giving the State second, eighth, and fourteenth position in these respective classes of iron ore.

New Jersey.—All of the iron ore mined in New Jersey is of the magnetite variety, in which class of ore it occupied first place in 1903, with a total of 484,796 long tons. This was an increase of 42,917 long tons, or nearly 10 per cent, over the 1902 production of 441,879 long tons.

The construction of several modern furnaces has been the predominating and instigating cause of the increased output in New Jersey, and it is probable that an augmented production may be expected in the near future.

Georgia.—In the year 1903 Georgia produced 443,452 long tons of iron ore, an advance of 78,562 tons, or 22 per cent, over the 1902 total of 364,890 long tons (including the quantity mined in North Carolina, which in the year 1903 is reported separately, owing to the increasing number of mines).

Of this total 318,804 long tons were brown hematite and 124,648 tons were red hematite.

Nevada, New Mexico, Utah, and Wyoming.—Nevada, New Mexico, Utah, and Wyoming contributed in the year 1903 392,242 long tons of iron ore, the greater portion of which, 235,599 long tons, was of the red hematite variety, the remainder being magnetite with a small amount of brown hematite. The increase over the year 1902 output of 362,034 long tons was 30,208 tons, or 8 per cent. In 1902 Montana was a producer of iron ore, while the Nevada mines were idle; in the year 1903 the reverse was the case.

Colorado.—In the year 1903 the amount of iron ore mined in this State was 252,909 tons, being 40,388 tons, or 14 per cent less than the 1902 production of 293,297 tons.

Of this total 249,288 tons were of the brown-hematite variety, the remainder, 3,621 tons, being red hematite.

The determination of exact statistics in regard to the iron ore mined in Colorado is difficult, as much of the ore comes from mines producing precious metals, but when iron ores do not contain sufficient quantities of silver, gold, lead, or manganese to cause them on that account to be valued at or in excess of about $12 per ton, and are used as fluxes by the smelters, they have been classed as iron ores.

Other States.—None of the other States reached a total production of 100,000 tons. Connecticut, Massachusetts, and Texas supplied brown hematite ore; Maryland, brown hematite and carbonate; Missouri, red and brown hematites; North Carolina, brown hematite and magnetite; and Ohio, carbonate ore.

PROMINENT IRON-ORE MINES.

In the year ending December 31, 1903, there were 141 iron-ore operations which produced over 50,000 tons each, the total being 31,301,938 long tons, or 89 per cent of the United States output. In 1902, 126 mines produced 31,561,628 long tons.

Of these larger mining operations 116 contributed 28,660,132 tons of red hematite, 15 supplied 1,336,337 tons of brown hematite, and 10 reported 1,305,469 tons of magnetite. Of these operations 1 reported over 1,500,000 tons, 1 over 1,300,000 tons, 2 over 1,200,000 tons, 2 over 1,000,000 tons, 2 over 800,000 tons, 2 over 700,000 tons, 3 over 600,000 tons, 4 over 500,000 tons, 3 over 400,000 tons, 9 over 300,000 tons, 13 over 200,000 tons, 35 over 100,000 tons, and 64 between 100,000 tons and 50,000 tons.

Of these larger mining operations 48 were in Minnesota, 46 in Michigan, 19 in Alabama, 6 in Tennessee, 4 each in Wisconsin and New Jersey, 3 in New York, 2 each in Pennsylvania, Virginia, Colorado, and Georgia, and 1 each in New Mexico, North Carolina, and Wyoming.

The table below gives a list of the mining operations in the United States which in the year 1903 produced over 50,000 long tons of iron ore, together with the States in which they are located and the quantity contributed by each, except 12 mines, the managers of which objected to such publication, these being grouped at the end.

Prominent iron-ore mines of the United States, with their production in 1903.

		Long tons.
Fayal, Minn		1,519,450
Mountain Iron, Minn		1,336,864
Adams, Minn		1,265,501
Red Mountain Group, Ala		1,231,409
Stevenson, Minn		1,014,608
Mahoning No. 3, Minn		1,010,327
Norrie Group, Mich		865,141
Biwabik, Minn		807,511
Lake Superior, Mich		706,267
Pioneer, Minn		703,925
Chapin, Mich		683,481
Spruce Mining Company, Minn		663,290
Burt, Minn		627,049
Aragon, Mich		552,898
Cleveland Lake, Mich	459,650	
Cleveland Hard Ore, Mich	65,753	
		525,403
Chandler, Minn		518,738
Pewabic, Mich		500,855
Aurora and Vaughn, Mich		468,518
Hull, Minn		429,860
Cornwall, Pa		401,470
Ashland, Mich		373,933
Penn Iron Mining Company, Mich		358,421
Genoa, Minn		346,678
Lake Angeline, Mich		325,200
Tilden, Mich		323,972
Regent Iron Company, Mich		321,680
Savoy-Sibley, Minn		312,655
Clark, Minn		304,328
Newport and Bonnie, Mich		295,507
Lincoln, Minn		284,677
Rust, Minn		257,413
Cliff's Shaft, Mich		252,506
Bristol (Claire), Mich		250,300
Sellers, Minn		247,691
Sunrise, Wyo		214,880
Pillsbury, Minn		214,026
Chisholm, Minn		213,003
Minnesota Iron Company, Minn		202,558
Leetonia, Minn		200,163
Brown Mining Company, Tenn		198,841
Glen, Minn		191,942
Champion, Mich		190,902
Jordan, Minn		190,353
Zenith, Minn		180,708
Negaunee, Mich		179,282
Salisbury, Mich		176,107
Montreal and Ottawa, Wis		173,149
Port Henry No. 21, N. Y		164,895
Great Western, Mich		163,795
Utica, Minn		158,154

	Long tons.
Atlantic, Wis	156,627
Duluth, Minn	150,053
Elba, Minn	142,987
Beaufort, Mich	141,900
Fierro and Union Hill, N. Mex	137,843
Crystal Falls, Mich	137,169
Riverton Group, Mich	131,673
Tobin and Genesee, Mich	131,022
Cyprus, Minn	122,641
Cundy, Mich	120,616
Ironaton Mines, Ala	120,572
Republic and West Republic, Mich	120,218
Florence, Wis	116,180
Albany, Minn	112,315
Day, Minn	111,587
Hemlock River, Mich	110,749
Clifford, Mich	108,277
Mikado, Mich	107,750
Oriskany, Va	107,293
Volunteer, Mich	107,035
Minorca, Minn	105,587
Loretto, Mich	104,498
Graces Gap, Ala	101,719
Bartow, Ga	97,758
Agnew, Minn	96,073
Croxton, Minn	95,877
Baltic, Mich	95,553
Raimund, Ala	93,636
Brotherton, Mich	93,061
Longyear, Minn	90,650
Helen-Bess, Ala	88,223
Richards, N. J	87,782
Princeton, Mich	87,396
Cary, West Cary, and Superior, Wis	87,393
Stephens, Minn	87,055
Sunday Lake, Mich	85,338
Lamont, Mich	80,394
Sparta, Minn	77,933
Eureka, Tenn	76,538
Lone Pine 1, 2, and 3, Ala	76,356
Laura, Minn	75,552
Smith, Tenn	74,379
Mannie, Tenn	74,357
Winthrop, Mich	72,433
Houston, Ala	71,690
Hammond Bros. & Company, Ala	70,172
Tannehill, Ala	69,622
La Follette Coal and Iron Company, Tenn	69,270
Hawkins, Minn	67,244
Mansfield, Mich	65,244
Sharon, Minn	64,835
La Belle, Minn	64,563
Pettit, Minn	60,378

	Long tons.
Union, Minn	60,079
Franklin, Minn	60,049
Hiawatha, Mich	60,000
Yale, Mich	59,460
Orient, Colo	58,848
Anvil, Mich	58,229
Estelle Mining Company, Ga	57,419
North Alabama Mining Company (Slope No. 1), Ala	57,216
Cambria, Mich	56,620
Grant, Minn	55,945
Richmond (Gribben), Mich	55,593
Lillie, Mich	55,162
Greeley Group, Ala	54,499
Alfretta, Ala	54,484
Midas, Colo	54,448
La Rue Mining Company, Minn	53,375
Verona, Mich	53,231
Hillman, Ala	53,166
Quinnesec, Mich	53,160
Cass, Minn	52,905
Scotia, Pa	52,763
Hartford, Mich	52,152
Chateaugay, N. Y	51,654
Pinkney Mining Company, Tenn	50,928
Pearce, Minn	50,439
St. Clair, Minn	50,257
Total	29,735,431
Twelve mines not reported by name	1,566,507
Total	31,301,938

SHIPMENTS OF IRON ORE FROM LAKE SUPERIOR REGION.

The greater portion of the iron ore mined in the Lake Superior region is sent by rail to seven shipping ports for transportation by water to ports on Lakes Erie and Michigan, and from these ports most of the ore received is forwarded by rail to blast furnaces and rolling mills in Pennsylvania, New York, Ohio, Virginia, West Virginia, Illinois, Wisconsin, Michigan, Kentucky, etc. Owing to the large stocks carried over and to the reduced demand, the distribution of Lake Superior iron ores will probably extend in 1904 over a greater territory than that named. Five of the seven shipping ports—Two Harbors, Duluth, Superior, Ashland, and Marquette—are located on Lake Superior, and two—Escanaba and Gladstone—are on the northwestern shore of Lake Michigan. Duluth and Two Harbors are in the State of Minnesota, Superior and Ashland in Wisconsin, and the others in Michigan.

Climatic conditions interfere with shipments by water and limit the season of ore transportation to about seven months.

The total amount of iron ore forwarded by water from the Lake Superior region during the year 1903 was 23,649,550 long tons, and in addition 632,045 tons were sent to points of consumption by all rail, a total of 24,281,595 long tons. The ports of Duluth and Two Harbors in 1903, as in 1902, head the list, but the relative positions are reversed, Duluth now ranking first with 5,356,473 long tons, followed by Two Harbors with 5,120,656 tons. Escanaba is third with a shipment of 4,277,561 tons, Superior fourth with 3,978,579 tons, Ashland fifth with 2,823,119 tons, Marquette sixth with 2,007,346 tons, and Gladstone last with 85,816 tons.

The shipments by ports from 1895 to 1903, inclusive, as supplied by the Iron Trade Review, are as follows:

Lake shipments of iron ore, 1895–1903, by ports.

Shipping port.	1895.	1896.	1897.	1898.	1899.
	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
Escanaba	2,860,172	2,321,981	2,302,121	2,803,513	3,720,218
Duluth	1,598,783	1,968,932	2,376,064	2,635,262	3,509,965
Ashland	2,350,219	1,566,236	2,067,637	2,391,088	2,703,447
Marquette	1,079,485	1,564,813	1,945,519	2,245,965	2,733,596
Superior	117,884	167,245	531,825	550,403	878,942
Gladstone	109,211	220,887	341,014	335,956	381,457
Total	10,233,910	9,644,036	12,215,645	13,655,432	17,901,358
All-rail shipments	195,127	290,792	253,993	369,241	350,446
Grand total	10,429,037	9,934,828	12,469,638	14,024,673	18,251,804

Shipping port.	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Two Harbors	4,007,294	5,018,197	5,605,185	5,120,656
Escanaba	3,436,734	4,022,668	5,413,704	4,277,561
Duluth	3,888,986	3,437,955	5,598,408	5,356,473
Ashland	2,633,687	2,886,252	3,553,919	2,823,119
Marquette	2,661,861	2,354,284	2,595,010	2,007,346
Superior	1,522,899	2,321,077	4,180,568	3,978,579
Gladstone	418,854	117,089	92,375	85,816
Total	18,570,315	20,157,522	27,039,169	23,649,550
All-rail shipments	489,078	431,715	531,952	632,045
Grand total	19,059,393	20,589,237	27,571,121	24,281,595

Most of the iron ore shipped from the upper lake ports is received at the Lake Erie ports, the quantity during the year 1903 being 19,681,731 long tons of iron ore. The difference between this quantity and 23,649,550 tons, the total tonnage forwarded by water from the shipping ports, represents the quantity forwarded to blast furnaces located on or near Lake Michigan, at Detroit, etc. There should be added to the total shipments the quantity of iron ore sent to the

United States from the Michipicoten Range of Ontario. The ore won from this Canadian range in 1903 was 223,976 long tons, of which 170,666 tons were sent to the United States, and 32,745 long tons were supplied to Canadian furnaces, the remainder being placed on the stock pile. This would therefore show a total of 4,138,485 long tons sent to blast furnaces at or near Chicago, Milwaukee, and in the lower peninsula of Michigan.

In 1903 Cleveland occupied first place as an iron-ore receiving port, with a total of 4,434,160 long tons of iron ore, followed by Ashtabula with 4,242,160 long tons, Conneaut with 3,903,937 tons, Buffalo and Tonawanda with 2,149,901 tons, Fairport with 1,434,342 tons, and Erie with 1,257,798 tons. Of the other Lake Erie ports, Lorain, Toledo, Huron, and Sandusky, none received 1,000,000 tons, but they ranked in the order named.

The following table presents the receipts of iron ore at lower lake ports from 1895 to 1903, inclusive:

Iron-ore receipts at Lake Erie ports, 1895–1903.

Port.	1895.	1896.	1897.	1898.	1899.
	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
Cleveland, Ohio	2,312,370	2,313,170	2,456,704	2,645,318	3,222,582
Conneaut, Ohio	244,967	327,623	495,327	1,404,169	2,320,696
Buffalo and Tonawanda, N. Y	719,742	545,101	797,446	1,075,975	1,530,016
Erie, Pa	811,989	847,849	1,311,526	1,092,364	1,309,961
Fairport, Ohio	914,617	941,446	1,008,340	912,879	1,241,013
Toledo, Ohio	260,730	301,794	416,438	414,012	792,348
Lorain, Ohio	214,219	191,445	355,188	536,086	1,112,946
Huron, Ohio	146,442	226,515	198,231	126,755	263,600
Sandusky, Ohio	12,361	58,667	79,792	136,200	87,499
Total	8.112,228	8,026,432	10,120,906	11,028,321	15,222,187

Port.	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Ashtabula, Ohio	3,709,486	3,981,170	4,796,805	4,242,160
Cleveland, Ohio	3,376,644	3,831,060	4,873,318	4,434,160
Conneaut, Ohio	2,556,631	3,181,019	4,300,301	3,903,937
Buffalo and Tonawanda, N. Y	1,616,919	1,475,386	2,256,798	2,149,901
Erie, Pa	1,240,715	1,379,377	1,717,268	1,257,798
Fairport, Ohio	1,085,554	1,181,776	1,538,744	1,434,342
Toledo, Ohio	645,147	798,298	1,037,571	652,305
Lorain, Ohio	1,090,235	721,662	1,442,417	990,490
Huron, Ohio	321,914	431,311	520,646	486,106
Sandusky, Ohio	154,542	33,017	165,556	130,532
Total	15,797,787	17,014,076	22,649,424	19,681,731

The bulk of the iron ores when received at lower lake docks is loaded on cars and forwarded directly to the blast furnaces, but quantities are also held in stock at the receiving ports to be shipped during the winter or as required at the furnaces. The quantity of ore on hand at lower lake ports on December 1, 1903, according to figures compiled by the Iron Trade Review, was 6,371,085 long tons, the largest stock of ore recorded with the exception of the year 1902, when the accumulation was 7,074,254 long tons. The stock on hand at lower lake ports on December 1, for the years 1895 to 1903, inclusive, is shown in the annexed table:

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

Port.	At close of navigation, December 1—				
	1895.	1896.	1897.	1898.	1899.
	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
Cleveland, Ohio	1,200,792	1,419,311	1,478,355	1,175,970	1,200,806
Fairport, Ohio	606,470	773,905	825,312	719,794	692,147
Erie, Pa	335,718	355,222	484,871	439,167	361,335
Lorain, Ohio	224,264	231,288	317,509	324,034	337,822
Conneaut, Ohio	292,460	275,800	360,895	288,101	468,808
Toledo, Ohio	113,132	115,959	194,644	146,568	186,422
Huron, Ohio	101,000	200,075	230,029	139,962	164,480
Buffalo, N. Y	207,199	82,267	111,660	121,620	192,681
Sandusky, Ohio	34,375	59,491	84,786	48,500	23,184
Total	4,415,712	4,954,984	5,923,755	5,136,407	5,530,283

Port.	At close of navigation, December 1—			
	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Ashtabula, Ohio	1,811,459	1,769,145	1,967,136	1,911,911
Cleveland, Ohio	1,337,445	1,378,060	1,500,604	1,337,750
Fairport, Ohio	611,717	710,590	924,236	845,946
Erie, Pa	480,734	470,718	722,966	657,409
Lorain, Ohio	251,838	195,863	328,304	288,581
Conneaut, Ohio	680,514	604,106	673,679	591,364
Toledo, Ohio	242,375	254,196	310,023	106,710
Huron, Ohio	211,377	231,501	232,764	253,249
Buffalo, N. Y	232,100	198,100	319,367	282,890
Sandusky, Ohio	95,111	47,384	95,175	95,275
Total	5,904,670	5,859,663	7,074,254	6,371,085

This accumulation of 6,371,085 tons of iron ore a lower lake ports in 1903 was not drawn upon as heavily as in previous years, and at the opening of navigation on the Lakes, May 1, 1904, there remained on the docks 4,534,103 tons, the largest total heretofore recorded.

In the spring of the year 1904, owing to strikes of employees of the lake carriers and to the practical disorganization of the Lake Superior Ore Association, efforts were made to approximate the quantity of Lake Superior ore on hand at blast furnaces. The total reported was close to 7,000,000 long tons on May 1, which, added to the stock of ore on hand at the lower lake ports, made a reserve of 11,500,000 tons at that date on which the furnaces could draw.

The stocks of iron ore on hand at the lower lake ports on May 1 for the years 1896 to 1904, inclusive, is given in the following table:

Stocks of iron ore at lower lake ports, 1896–1904.

Port.	At opening of navigation, May 1—				
	1896.	1897.	1898.	1899.	1900.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Ashtabula, Ohio	636,254	926,865	1,031,441	855,691	678,789
Cleveland, Ohio	506,693	979,705	853,776	472,946	386,291
Fairport, Ohio	346,847	480,984	501,592	289,417	282,298
Erie, Pa	137,826	153,261	236,485	95,626	97,894
Lorain, Ohio	118,820	180,605	158,797	168,646	126,212
Conneaut, Ohio	112,406	207,034	69,047	6,115	8,649
Toledo, Ohio	10,593	66,337	71,726	22,915	52,616
Huron, Ohio	55,173	162,292	143,170	82,055	48,412
Buffalo, N. Y	16,644	50,477	53,081	72,757	35,195
Sandusky, Ohio	8,442	48,937	48,800	7,086	4,300
Total	1,949,698	3,256,497	3,167,915	2,073,254	1,720,656

Port.	At opening of navigation, May 1—			
	1901.	1902.	1903.	1904.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Ashtabula, Ohio	1,046,974	924,742	1,073,967	1,559,028
Cleveland, Ohio	806,119	624,865	829,347	968,508
Fairport, Ohio	306,706	472,325	555,709	579,677
Erie, Pa	225,412	223,972	426,744	474,275
Lorain, Ohio	140,562	96,992	190,311	237,404
Conneaut, Ohio	69,755	152,891	125,400	128,018
Toledo, Ohio	138,457	111,511	126,331	160,216
Huron, Ohio	135,043	129,635	147,817	208,008
Buffalo, N. Y	118,007	73,861	60,241	150,106
Sandusky, Ohio	63,148	37,400	56,500	68,863
Total	3,050,183	2,848,194	3,592,367	4,534,103

VALUE OF IRON ORES.

The total value at the mines of the 35,019,308 long tons of iron ore produced in the United States in the year 1903 was $66,328,415, or $1.89 per ton, an increase of 5 cents per ton, or 3 per cent, over the 1902 figures of $1.84.

The selling prices of the Lake Superior ores, which form the greater portion of the United States total, have in late years been fixed by the Lake Superior Ore Association, and in the year 1903 these figures were the same as in 1902, as follows: A basis price of $4.50 per long ton, free on board at lower lake ports, for old Range Bessemer ores 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. For old Range non-Bessemer ores, free on board at lower lake ports, basis price, $3.60 per ton, guaranteed to contain 60 per cent of iron and

12 per cent of moisture. For Mesabi Range Bessemer ores, free on board at lower lake ports, basis price $4 per ton, guarantee, 63 per cent of iron, 0.045 phosphorus, 10 per cent moisture. For Mesabi Range non-Bessemer ores, free on board at lower lake ports, basis price, $3.20 per ton, guarantee, 60 per cent of iron and 12 per cent moisture. These Mesabi non-Bessemer ores are divided into three classes, according to physical structure, with a differential of 15 cents between the first and second classes and 10 cents between the second and third classes, or a total differential of 25 cents between the first and third classes.

The returns collated show that the highest average value at the mine in 1903 was placed on the Colorado iron ores, viz, $3.12 per ton, and the lowest on Texas ores, $1 per ton. Generally speaking, there were but slight changes in the various States between the prices which prevailed in 1902 and in 1903. Of the States comprising the Lake Superior region, Michigan reported the same average price as in 1902, $2.40 per ton, Minnesota an advance of 17 cents, and Wisconsin a decline of 1 cent from the respective 1902 valuations of $1.58 and $2.30 per ton.

The following table gives the total production and value of the iron ore produced in 1903, by States, together with the average value per ton at the mines:

Quantity and value of iron ore produced in 1903, by States.

State.	Quantity.	Total value at mines.	Average value per ton.
	Long tons.		
Minnesota	15,371,396	$26,833,043	$1.75
Michigan	10,600,330	25,483,075	2.40
Alabama	3,684,960	3,939,600	1.07
Tennessee	852,704	1,075,619	1.26
Virginia and West Virginia	801,161	1,432,624	1.79
Wisconsin	675,053	1,542,517	2.29
Pennsylvania	644,599	1,062,455	1.65
New York	540,460	1,209,899	2.24
New Jersey	481,796	1,330,745	2.74
Georgia	443,452	571,124	1.29
Nevada, New Mexico, Utah, and Wyoming	392,242	612,499	1.56
Colorado	252,909	787,824	3.12
North Carolina	75,252	99,885	1.33
Missouri	63,380	110,127	1.71
Texas	34,050	34,050	1.00
Kentucky	32,227	46,547	1.44
Connecticut and Massachusetts	30,729	82,214	2.68
Ohio	29,688	51,956	1.75
Maryland	9,920	22,612	2.28
Total	35,019,308	66,328,415	1.89

STOCKS OF IRON ORES.

On December 31, 1903, the total stock of iron ore on hand at the mines was reported as 6,297,888 long tons, an increase of 2,463,171 long tons, or 64 per cent, over the 3,834,717 tons reported at the close of the year 1902. As would naturally be expected, the greater portion of this ore, 5,976,249 long tons, was in the Lake Superior region, of which 3,810,751 tons were in Michigan. The large stocks of ore in this district are due to the fact that the greater part is forwarded to lower lake ports by water, and when navigation is suspended the stocks accumulate rapidly. The ore on hand at the mines at the close of the year 1903 was 18 per cent of the production of the United States during the year.

The following table gives the stock of ore on hand at the mines on December 31, 1903, by States:

Stocks of iron ore on hand December 31, 1903, by States.

State.	Quantity.	State.	Quantity.
	Long tons.		*Long tons.*
Michigan	3,810,751	Georgia and North Carolina	14,999
Minnesota	1,920,438	Pennsylvania	9,604
Wisconsin	245,060	Missouri	5,865
Alabama	126,157	Virginia and West Virginia	4,528
New York	59,741	Ohio	2,350
New Jersey	48,427	Maryland	612
Texas	18,500	Connecticut and Massachusetts	438
Tennessee	16,668	Total	6,297,888
Nevada and Utah	13,750		

IMPORTS OF IRON ORE.

The following tables furnished by the Bureau of Statistics of the Department of Commerce and Labor show the imports and exports of iron ore into and from the United States during the calendar year 1903.

Considerable quantities of iron ore are annually imported into the United States. The Bureau of Statistics reports this import for 1903 as 980,440 long tons, valued at $2,261,008, or $2.31 per ton; this was a decrease in quantity of 185,030 long tons, or 16 per cent from the 1902 total of 1,165,470 long tons, which was valued at $2,583,077, or $2.22 per ton. The island of Cuba, where the mines are owned by American companies, contributed 63 per cent of the imported ore, followed by Canada, Spain, and Newfoundland. Smaller amounts were supplied by Algeria, the United Kingdom, British Columbia, Belgium, and Germany.

In considering the valuation of these ores it should be borne in mind that the value is placed on them at the port of shipment and does not include freights nor the duty of 40 cents per ton. It is also evident from the relatively high value placed on the ores from some countries that the estimate is based on some other constituent than the iron contained in the ore.

The following table shows the importation of iron ore by countries for the years 1897 to 1903, inclusive:

Quantity and value of iron ores imported into the United States, 1897–1903, by countries.

Imported from—	1897.		1898.		1899.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Cuba	383,820	$454,709	165,623	$187,721	360,813	$449,616
Spain	66,198	167,878	13,335	34,932	145,206	339,058
French Africa	3,504	7,785			22,233	51,746
Italy					43,363	122,786
Greece			7,200	26,581	16,765	27,556
Newfoundland and Labrador	29,250	29,431			77,970	77,970
United Kingdom	358	4,091	683	5,385	172	994
Colombia						
Portugal	3,612	5,831				
Other countries	3,233	9,187	367	929	7,560	13,121
Total	489,970	678,912	187,208	255,548	674,082	1,082,847

Imported from—	1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
Cuba	431,265	$587,496	526,583	$705,086	696,375	$1,576,619	613,585	$1,501,480
Spain	258,694	494,668	180,810	399,364	153,527	338,259	94,720	196,139
French Africa	20,000	23,536			19,167	35,707	7,830	14,586
Italy	18,951	50,945						
Greece	23,350	81,685	12,950	42,896				
Newfoundland and Labrador	140,535	142,685	a 79,360	79,360	81,920	81,918	a 86,730	86,680
United Kingdom	397	3,274	490	15,939	1,269	17,882	6,843	31,868
Colombia	3,000	4,854						
British Columbia			2,875	4,313	5,661	9,312	525	789
Germany	145	1,339	400	3,415	361	3,478	207	1,820
Netherlands	181	854						
Quebec, Ontario, etc	5,588	10,139	163,383	408,431	203,824	509,711	169,681	424,440
Venezuela	700	1,621						
Sweden and Norway	25	100						
Belgium					500	4,850	300	2,964
France					2,866	5,341		
Other countries			b 99	469			19	242
Total	897,831	1,303,196	966,950	1,659,273	1,165,470	2,583,077	980,440	2,261,008

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.

The greater portion of the iron ore imported into the United States is received at the Atlantic ports, the total in 1903 being 805,629 tons, principally at the ports of Philadelphia and Baltimore, at which 303,722 and 490,920 tons, respectively, were brought in.

The lake ports rank second with 169,681 long tons, most of which came from the Michipicoten range in Canada and was sent to Buffalo. It is only in late years since the opening of this range that these ports have become prominent as receivers of foreign ore.

Small quantities were imported at Pensacola, Fla., and at the Pacific coast ports, the latter being used principally at the Irondale Furnace, Washington, when it is active, and at the precious-metal smelters.

The iron ore imported by customs districts into the United States in the years 1898 to 1903, inclusive, is given in the following table:

Imports of iron ore into the United States, 1898–1903, by customs districts.

Port.	1898.		1899.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Baltimore, Md	144,213	$178,905	333,258	$516,888	448,660	$629,507
Delaware			5,757	7,375	3,331	5,305
Philadelphia, Pa	42,861	74,226	330,594	549,130	414,064	589,749
New York, N. Y	119	1,815	120	703	25,878	63,540
Boston, Mass			75	175	15	71
Newport News, Va	15	602				
Norfolk and Portsmouth, Va						
Total Atlantic ports	187,208	255,548	669,804	1,074,271	891,948	1,288,172
Cape Vincent, N. Y			195	489		
Buffalo Creek, N. Y			20	52	1,023	586
Cuyahoga, Ohio					2,456	6,141
Champlain, N. Y			641	1,555	286	520
Detroit, Mich			304	168	52	78
Genesee, N. Y					211	442
Oswegatchie, N. Y			125	260	1,131	2,064
Vermont			1,039	2,045	257	454
Erie						
Miami						
Total lake ports			2,324	4,569	5,366	10,285
Saluria, Tex. (total Gulf ports)			2	17		
Puget Sound, Wash			1,912	3,746	424	3,781
San Francisco, Cal						
San Diego, Cal						
Los Angeles, Cal						
Total Pacific ports			1,912	3,746	424	3,781
Pittsburg, Pa			40	244	93	958
Evansville, Ind						
Total interior ports			40	244	93	958
Total imports	187,208	255,548	674,082	1,082,847	897,831	1,303,196

Imports of iron ore into the United States, 1898–1903—Continued.

Port.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Baltimore, Md	484,035	$733,071	600,711	$1,401,326	490,920	$1,232,546
Delaware	....	....	....	....	....	....
Philadelphia, Pa	298,255	459,698	338,848	597,895	303,722	560,880
New York, N. Y	15,865	45,863	14,546	39,800	6,940	19,759
Boston, Mass	....	....	50	142	650	2,435
Newport News, Va	....	....	197	8,130	3,397	8,825
Norfolk and Portsmouth, Va	1,850	1,850	....	....	....	....
Total Atlantic ports	800,005	1,240,482	954,352	2,047,293	805,629	1,824,445
Cape Vincent, N. Y	....	....	....	....	....	....
Buffalo Creek, N. Y	53,327	146,596	53,286	133,377	23,167	57,798
Cuyahoga, Ohio	107,810	256,936	123,476	308,951	122,021	305,804
Champlain, N. Y	63	149	34	38	171	928
Detroit, Mich	32	49	73	112	55	133
Genesee, N. Y	....	....	....	....	....	....
Oswegatchie, N. Y	2,083	4,485	139	209	182	273
Vermont	48	186	18	72	760	1,190
Erie	....	....	22,821	57,024	23,325	58,314
Miami	....	....	3,962	9,905	....	....
Total lake ports	163,363	408,401	203,809	509,688	169,681	424,440
Pensacola, Fla. (total Gulf ports)	....	....	....	....	4,100	6,560
Puget Sound, Wash	2,875	4,313	5,661	9,312	525	789
San Francisco, Cal	550	4,875	1,241	12,581	200	1,989
San Diego, Cal	87	442	....	....	....	....
Los Angeles, Cal	....	....	357	3,461	305	2,785
Total Pacific ports	3,512	9,630	7,259	25,354	1,030	5,563
Pittsburg, Pa	50	730	50	742	....	....
Evansville, Ind	20	30	....	....	....	....
Total interior ports	70	760	50	742	....	....
Total imports	966,950	1,659,273	1,165,470	2,583,077	980,440	2,261,008

EXPORTS.

Until about five years ago the exportation of iron ore from the United States was comparatively unimportant, but in 1899 and in subsequent years moderate quantities have been shipped, the greater portion of which was sent to blast furnaces located in the Province of Ontario, Canada, and elsewhere in eastern Canada. Some shipments were also made to European countries, and it is not improbable that this will be repeated. The total exports in the year 1903 were 80,611 tons, valued at $255,728. This was a decrease of 7,834 tons from the 1902 shipments of 88,445 long tons.

In the following table will be found the exports of iron ore from the United States, by customs districts, for the years 1899 to 1903, inclusive:

Exports of iron ore from the United States, 1899–1903, by customs districts.

Customs district.	1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
New York						
Niagara	17,857	$30,000				
Superior	11,389	20,012	11,004	$35,213	8,982	$19,754
Duluth	10,534	22,465	38,485	113,962	34,966	83,744
Paso del Norte	703	2,930				
Saluria	172	823				
Detroit	7	42	34	120	40	257
Huron	3	15				
Champlain					9,219	24,258
Newport News			8	128		
Buffalo Creek			120	300	9,849	31,061
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

Customs district.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
New York	204	$2,227	331	$2,000
Niagara	802	1,708		
Superior	19,157	63,772	70,870	223,432
Duluth	49,233	152,454	5,006	13,463
Paso del Norte				
Saluria				
Detroit	115	408		
Huron				
Champlain	18,876	73,348	4,314	16,548
Newport News				
Buffalo Creek	58	251	90	285
Memphremagog				
Vermont				
Total	88,445	294,168	80,611	255,728

CUBA.

As all the active iron-ore mines in the island of Cuba are situated in the province of Santiago de Cuba, in the southeastern section of the island, and are owned and operated by American companies, most of the ore produced is shipped to the United States.

The Juragua Iron Company (Limited), the pioneer, made its first shipment in 1884, and contributed up to the close of 1903, 4,067,693 long tons of iron ore, the total for the latter year being 155,898 tons.

The only other company active is the Spanish-American Iron Company, which commenced exporting ore in 1895 and supplied 2,244,841 tons to the close of 1903, of which 467,723 tons were shipped in the latter year. In 1892 and 1893 the Sigua Iron Company produced 20,438 tons, and in 1901 and 1902 the Cuban Steel Ore Company produced 41,241 tons; but both of these operations have been abandoned.

The total amount shipped from the island of Cuba from the year 1884 to 1903, inclusive, was 6,374,213 long tons, of which all but 81,060 tons were sent to the United States.

A summary of the shipments of Cuban ore from the time of opening to date, which has been prepared by Mr. Josiah Monroe, of Philadelphia, is of interest.

Shipments of iron ore from mines in the province of Santiago de Cuba, 1884–1903.

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
1903	155,898		[d] 467,723		623,621
Total	4,067,693	20,438	2,244,841	41,241	6,374,213

[a] Of this quantity, 5,932 tons were sent to Pictou, Nova Scotia.
[b] Of this quantity, 51,587 tons were sent to foreign ports.
[c] Of this quantity, 12,691 tons were sent to foreign ports.
[d] Of this quantity, 10,900 tons were sent to foreign ports.

Total...... 81,060 tons sent to foreign ports.

STATISTICS OF THE AMERICAN IRON TRADE FOR 1903.

By James M. Swank,

General Manager of the American Iron and Steel Association.

BRIEF REVIEW OF THE IRON TRADE IN 1903 AND 1904.

The prosperity which characterized the iron trade of the United States from the beginning of 1899 to 1902 and throughout the early part of 1903, as noticed in previous reports, was suddenly checked about the middle of the last year by a sharp reaction in the stock market, which caused a decline in the demand for iron and steel and a consequent decline in prices. Production in the first half of the year had been on a large scale, fairly comparable with any half year since the beginning of the boom of 1899, and prices had been as a whole satisfactory, but in the last half of the year both production and prices declined rapidly. Soon after the beginning of the year 1904, however, there was a revival of activity in production, but prices did not rally. April and May, 1904, were especially active months, but with slight increase in prices. June and July were characterized by a sluggish demand. August, September, and October were again active months. Prices, except in some special products and for special reasons, have been remarkably uniform all through 1904. In September and October there was a distinct revival of confidence and hopefulness in the iron trade, and as this report is written, in the latter part of October, there are few signs of the reaction which began a little more than a year ago. The prices of pig iron have advanced in October. The stock market has recovered its buoyancy, and this recovery has been a leading cause of the revival of the iron trade. Details of production and prices and of imports and exports for 1903 and immediately preceding years will be found in succeeding pages. Some prices for the first ten months of 1904 have been added.

GENERAL STATISTICAL SUMMARY.

The following table gives the shipments in 1902 and 1903 of Lake Superior iron ore, the shipments of coke and of anthracite coal, the total production of iron ore, coal, and coke, and of all iron and steel, the imports and exports of iron and steel, etc.:

Summary of iron, steel, etc., statistics for the United States for 1902 and 1903.

[Long tons, except for coke and nails.]

Article.	1902.	1903.
Shipments of iron ore from Lake Superior	27,571,121	24,289,878
Total production of iron ore	35,554,135	35,019,308
Shipments of Pennsylvania anthracite coal	31,200,890	59,362,831
Total production of all kinds of coal	269,277,178	319,068,229
Total production of coke ....short tons..	25,401,730	25,262,360
Shipments of Connellsville coke ....do....	14,138,740	13,345,230
Shipments of Pocahontas Flat Top coke ....do....	1,191,436	1,693,403
Production of pig iron, including spiegeleisen and ferromanganese	17,821,307	18,009,252
Production of spiegeleisen and ferromanganese	212,981	192,661
Production of Bessemer steel ingots and castings	9,138,363	8,592,829
Production of open-hearth steel ingots and castings	5,687,729	5,829,911
Production of all kinds of steel	14,947,250	14,534,978
Production of structural shapes, not including plates	1,300,326	1,095,813
Production of plates and sheets, except nail plate	2,665,409	2,599,665
Production of all rolled iron and steel, except rails	10,996,183	10,215,220
Production of Bessemer steel rails	2,935,392	2,946,756
Production of all kinds of rails	2,947,933	2,992,477
Production of iron and steel wire rods	1,574,293	1,503,455
Production of all rolled iron and steel, including rails	13,944,116	13,207,697
Production of iron and steel cut nails ....kegs of 100 pounds..	1,633,762	1,435,893
Production of iron and steel wire nails ....do....	10,982,246	9,631,661
Imports of iron ore	1,165,470	980,440
Exports of iron ore	88,445	80,611
Imports of iron and steel ....value..	$41,468,826	$41,255,864
Exports of iron and steel ....do....	$97,892,036	$99,035,865

The shipments of Lake Superior iron ore in 1903 were 3,281,243 tons less than in 1902, but the country's total production of iron ore in 1903 was only 534,827 tons less than in 1902. The shipments of Connellsville coke in 1903 declined 793,510 short tons as compared with 1902. The shipments of Pocahontas Flat Top coke increased 501,967 short tons as compared with 1902. The total production of coke in 1903 was 139,370 short tons less than in 1902. The shipments of Pennsylvania anthracite coal in 1903 increased 28,161,941 long tons over the shipments of the strike year 1902. The production of all kinds of coal in 1903 increased 49,791,051 long tons over 1902.

The production of all kinds of pig iron increased 187,945 long tons in 1903 over 1902, but the production of spiegeleisen and ferromanganese decreased 20,320 tons. The production of Bessemer steel decreased 545,534 long tons; open-hearth steel increased 142,182 tons;

all kinds of steel decreased 412,272 tons; structural shapes decreased 204,513 tons, and plates and sheets 65,744 tons; Bessemer steel rails increased 11,364 tons, and all kinds of rails 44,544 tons; iron and steel wire rods decreased 70,838 tons; iron and steel cut nails, 197,869 kegs; iron and steel wire nails, 1,350,585 kegs, and all kinds of rolled iron and steel, 736,419 long tons.

Our imports and exports of iron and steel in 1903 corresponded closely with the imports and exports in 1902. The imports in 1903 amounted in value to $41,255,864, against $41,468,826 in 1902, and the exports in 1903 amounted to $99,035,865, against $97,892,036 in 1902. The imports in 1903 were, of course, largely in response to orders sent abroad before the reaction of that year. In the year 1904 the imports will be much less than in 1903 and the exports will be much greater.

IMPORTS OF IRON AND STEEL.

The following table, compiled from statistics obtained from the Bureau of Statistics of the Department of Commerce and Labor, gives the quantities and values of our imports of iron and steel and manufactures thereof in the calendar years 1902 and 1903:

Imports of iron and steel into the United States in 1902 and 1903.

Article.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Pig iron, spiegeleisen, and ferromanganese	619,354	$10,935,831	599,574	$11,173,302
Scrap iron and scrap steel	109,510	1,606,720	82,921	1,273,941
Bar iron	28,844	1,286,238	43,398	1,904,469
Iron and steel rails	63,522	1,576,679	95,555	2,159,278
Hoop, band, and scroll iron or steel	3,362	131,052	1,525	74,898
Steel ingots, billets, blooms, etc	289,318	7,943,818	261,570	7,331,299
Sheet, plate, and taggers iron or steel	7,156	545,789	11,557	540,272
Building forms and all other structural shapes, fitted for use	....	....	8,865	256,265
Tin plates	60,115	4,023,421	47,360	2,999,252
Wire rods, of iron or steel	21,382	1,033,074	20,836	1,028,977
Wire and wire rope, of iron or steel	3,469	606,724	5,018	728,430
Anvils	203	29,746	250	35,378
Chains	576	55,456	373	62,481
Cutlery	....	1,672,054	....	1,903,895
Files, file blanks, rasps, and floats	....	80,280	....	82,939
Firearms	....	953,801	....	687,917
Shotgun barrels, in single tubes	....	263,882	....	198,126
Machinery	....	4,230,708	....	3,927,165
Needles	....	417,429	....	466,294
All other	....	4,076,174	....	4,421,291
Total	1,206,811	41,468,826	1,178,797	41,255,864

Of the pig iron imported in recent years a large part was spiegeleisen and ferromanganese, but in 1902 and 1903 there was a great increase in the imports of foundry and Bessemer pig iron.

IMPORTS FOR CONSUMPTION OF FERROMANGANESE, SPIEGELEISEN, AND FERROSILICON.

The Bureau of Statistics of the Department of Commerce and Labor furnishes the following statistics of the imports of ferromanganese, spiegeleisen, and ferrosilicon which were entered for consumption in the calendar years 1901, 1902, and 1903. These imports are included in the statistics of imports of pig iron, spiegeleisen, ferromanganese, and ferrosilicon given in the preceding table.

Imports of ferromanganese, spiegeleisen, and ferrosilicon into the United States in 1901, 1902, and 1903.

Article.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Ferromanganese	20,751	$870,828	50,388	$1,818,036	41,518	$1,699,666
Spiegeleisen	26,827	677,246	62,813	1,473,853	122,016	2,709,317
Ferrosilicon	822	21,224	15,944	362,110	14,880	379,900

IMPORTS OF TIN PLATES SINCE 1872.

The following table gives the quantities and foreign values of our imports of tin plates in the calendar years 1872 to 1903. The decline in imports since 1891 is a result of the tariff of 1890. The domestic consumption of tin plates and terne plates has greatly increased in late years.

Imports of tin plates into the United States, 1872–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1872	85,629	$13,898,450	1888	298,238	$19,762,961
1873	97,177	14,240,868	1889	331,311	21,726,707
1874	79,778	13,057,658	1890	329,435	23,670,158
1875	91,054	12,098,885	1891	327,882	25,900,305
1876	89,946	9,416,816	1892	268,472	17,102,487
1877	112,479	10,679,028	1893	253,155	15,559,423
1878	107,864	9,069,967	1894	215,068	12,053,167
1879	154,250	13,227,659	1895	219,545	11,482,380
1880	158,049	16,478,110	1896	119,171	6,140,161
1881	183,005	14,886,907	1897	83,851	4,366,828
1882	213,987	17,975,161	1898	66,775	3,311,658
1883	221,233	18,156,773	1899	58,915	3,738,567
1884	216,181	16,858,650	1900	60,386	4,617,813
1885	228,596	15,991,152	1901	77,395	5,294,789
1886	257,822	17,504,976	1902	60,115	4,023,421
1887	283,836	18,699,145	1903	47,360	2,999,252

EXPORTS OF IRON AND STEEL.

As reported by the Bureau of Statistics of the Department of Commerce and Labor, the domestic exports of iron and steel in the calendar years 1902 and 1903 were as follows:

Exports of iron and steel in 1902 and 1903.

Article.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Pig iron	27,487	$502,947	20,379	$384,334
Scrap and old	9,411	149,013	8,034	117,972
Bar iron	22,249	869,519	19,380	796,631
Steel bars or rods other than wire rods	9,300	608,144	17,802	929,915
Steel wire rods	24,613	831,067	22,449	713,718
Iron rails	211	4,639	181	8,808
Steel rails	67,455	1,902,396	30,656	937,779
Billets, ingots, and blooms	2,409	74,938	5,445	141,924
Hoop, band, and scroll	1,674	82,322	2,141	101,839
Iron sheets and plates	3,434	229,887	4,782	273,618
Steel sheets and plates	14,866	725,547	13,312	657,713
Tin plates and terne plates	1,566	143,691	292	28,481
Structural iron and steel	53,859	2,828,460	30,641	1,788,556
Wire	97,843	5,140,702	108,521	5,528,726
Cut nails and spikes	7,198	339,227	8,890	424,985
Wire nails and spikes	26,580	1,181,140	31,453	1,410,105
All other, including tacks	2,244	275,628	2,321	288,395
Car wheels .... number	21,714	141,969	18,966	136,569
Castings, not elsewhere specified		1,685,660		1,765,901
Cutlery		282,454		389,837
Firearms		976,967		1,206,951
Cash registers .... number	14,018	1,220,791	20,260	1,825,503
Locks, hinges, etc		7,044,375		6,986,357
Saws		345,895		495,729
Tools, not elsewhere specified		3,930,495		4,658,972
Electrical machinery		5,937,613		5,104,502
Laundry machinery		519,065		552,291
Metal-working machinery		2,863,709		3,316,088
Printing presses, and parts of		843,613		1,143,122
Pumps and pumping machinery		2,516,300		2,729,288
Sewing machines		4,606,791		5,340,474
Shoemaking machinery		788,377		834,995
Fire engines .... number	11	23,608	8	16,657
Locomotive engines .... do	368	3,966,007	287	3,099,521
Stationary engines .... do	1,280	672,957	1,730	714,508
Parts of engines and boilers		2,432,098		2,273,834
Typewriting machines, and parts of		3,575,909		4,537,396
Wood-working machinery[a]				359,338
All other machinery		20,930,519		20,068,810
Pipes and fittings		5,107,183		5,919,340
Safes .... number	2,950	162,043	3,740	209,514
Scales and balances		506,877		762,305
Stoves, ranges, and parts of		868,695		981,475
All other manufactures		10,052,766		9,073,059
Total	372,399	97,892,036	326,679	99,035,865
Agricultural implements, additional		17,981,597		22,951,805
Iron ore	88,445	294,168	80,611	255,728

[a] Included in "All other machinery, etc.," prior to July 1, 1903.

EXPORTS OF AGRICULTURAL IMPLEMENTS.

The exports of agricultural implements, not separated in the foregoing table, amounted in the calendar year 1903 to $22,951,805, against $17,981,597 in 1902, $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 AND EXPORTS OF IRON AND STEEL SINCE 1872.

The following table, compiled from the reports of the Bureau of Statistics of the Department of Commerce and Labor, shows the foreign value of the imports of iron and steel and manufactures thereof in the calendar years from 1872 to 1903, including tin plates; also the value of the exports of iron and steel and manufactures thereof, except farm implements, in the same years:

Value of imports and exports of iron and steel into the United States, 1872–1903.

Year.	Imports.	Exports.	Year.	Imports.	Exports.
1872	$75,617,677	$12,595,539	1888	$42,311,689	$19,578,489
1873	60,005,538	14,173,772	1889	42,027,742	23,712,814
1874	37,652,192	17,312,239	1890	44,540,413	27,000,134
1875	27,368,101	17,976,833	1891	41,983,626	30,736,507
1876	20,016,603	13,647,764	1892	33,882,447	27,900,862
1877	19,874,399	18,549,922	1893	29,656,539	30,159,363
1878	18,013,010	15,101,899	1894	20,843,576	29,943,729
1879	33,331,569	14,223,646	1895	25,772,136	35,071,563
1880	80,443,362	15,156,703	1896	19,506,587	48,670,218
1881	61,555,077	18,216,121	1897	13,835,950	62,737,250
1882	67,075,125	22,348,834	1898	12,474,572	82,771,550
1883	47,506,306	22,716,040	1899	15,800,579	105,690,047
1884	37,078,122	19,290,895	1900	20,443,911	129,633,480
1885	31,144,552	16,622,511	1901	20,395,015	102,534,575
1886	41,630,779	14,865,087	1902	41,468,826	97,892,036
1887	56,420,607	16,235,922	1903	41,255,864	99,035,865

IMPORTS OF IRON AND STEEL INTO THE UNITED STATES SINCE 1884.

In the following table the total weight of imported iron and steel, including tin plates, is given for the last twenty years. In none of the years, however, is the weight of machinery, hardware, cutlery, firearms, and similar manufactured products included.

Imports of iron and steel into the United States, 1884–1903.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1884	654,696	1891	557,882	1898	144,385
1885	578,478	1892	494,468	1899	173,220
1886	1,098,565	1893	438,495	1900	209,955
1887	1,783,256	1894	309,249	1901	221,292
1888	914,940	1895	378,208	1902	1,206,811
1889	748,550	1896	265,500	1903	1,178,797
1890	665,771	1897	157,834		

PRODUCTION OF IRON ORE IN 1902 AND 1903.

The following table, compiled from statistics obtained by Mr. John Birkinbine for the United States Geological Survey, gives the production of iron ore in 1902 and 1903, by States:

Production of iron ore in the United States in 1902 and 1903, by States.

State or Territory.	1902.	1903.
	Long tons.	*Long tons.*
Minnesota	15,137,650	15,371,396
Michigan	11,135,215	10,600,330
Alabama	3,574,474	3,684,960
Tennessee	874,542	852,704
Virginia and West Virginia	987,958	801,161
Wisconsin	783,996	675,053
Pennsylvania	822,932	644,599
New York	555,321	540,460
New Jersey	441,879	484,796
Georgia	364,890 (Georgia and North Carolina)	443,452
North Carolina		75,252
Montana, Nevada, New Mexico, Utah, and Wyoming	362,084	392,242
Colorado	293,297	252,909
Missouri	66,308	63,380
Texas	6,516	34,050
Kentucky	71,006	32,227
Connecticut, Massachusetts, and Vermont	29,093	30,729
Ohio	22,657	29,688
Maryland	24,367	9,920
Total	35,554,135	35,019,308

The production of iron ore in any given year must not be confounded with the shipments of iron ore in that year.

PRODUCTION OF IRON ORE SINCE 1870.

Previous to 1870 statistics of the production of iron ore in the United States are incomplete. The figures in the following table for 1870 and 1880 are for the census years ending on May 31. For 1889 (also the census year) and all subsequent years they are for calendar years. The iron-ore statistics for all years subsequent to 1889 have been compiled by Mr. Birkinbine for the United States Geological Survey.

Production of iron ore in the United States since 1870.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1870	3,031,891	1893	11,587,629	1899	24,683,173
1880	7,120,362	1894	11,879,679	1900	27,553,161
1889	14,518,041	1895	15,957,614	1901	28,887,479
1890	16,036,043	1896	16,005,449	1902	35,554,135
1891	14,591,178	1897	17,518,046	1903	35,019,308
1892	16,296,666	1898	19,433,716		

LAKE SUPERIOR IRON-ORE SHIPMENTS.

The Iron Trade Review gives full details of the shipments of iron ore from the Lake Superior region in 1903 and in preceding years. The total shipments by water and by all-rail routes in 1903 amounted to 24,289,878 long tons, against 27,571,121 tons in 1902, a decrease of 3,281,243 tons, or almost 12 per cent. The shipments in 1903 from the Helen mine on the Canadian side, 203,419 tons, are not included. Of these shipments 170,672 tons were shipped to Lake Erie ports in the United States.

The following tables give the shipments in long tons of Lake Superior iron ore in the last four years by ranges and by ports and all-rail. The figures include all shipments to local furnaces.

Shipments of Lake Superior iron ore, 1900–1903, by ranges and by ports.

[Long tons.]

	1900.	1901.	1902.	1903.
RANGE.				
Marquette range	3,457,522	3,245,346	3,868,025	3,040,245
Menominee range	3,261,221	3,619,083	4,612,509	3,749,567
Gogebic range	2,875,295	2,938,155	3,663,484	2,912,912
Vermilion range	1,655,820	1,786,063	2,084,263	1,676,699
Mesabi range	7,809,535	9,004,890	13,342,840	12,892,542
Iron Ridge mine	....	....	....	17,913
Total	19,059,393	20,593,537	27,571,121	24,289,878
PORT.				
Escanaba	3,436,734	4,022,668	5,413,704	4,277,561
Marquette	2,661,861	2,354,284	2,595,010	2,007,346
Ashland	2,633,687	2,886,252	3,553,919	2,823,119
Two Harbors	4,007,294	5,018,197	5,605,185	5,120,656
Gladstone	418,854	117,089	92,375	85,816
Superior	1,522,899	2,821,077	4,180,568	3,978,579
Duluth	3,888,986	3,437,955	5,598,408	5,356,473
All-rail	489,078	436,015	531,952	640,328
Total	19,059,393	20,593,537	27,571,121	24,289,878

The Marquette range is wholly in Michigan, the Menominee and the Gogebic ranges are partly in Michigan and partly in Wisconsin, and the Vermilion and the Mesabi ranges are in Minnesota. The 17,913 tons of iron ore shipped in 1903 from the Iron Ridge mine, at Iron Ridge, Dodge County, Wis., can not strictly be credited to the Lake Superior region, Dodge County being in the southern part of Wisconsin. Prior to 1903 this mine was never included in Lake Superior statistics. The newly developed Baraboo iron ore field is in the adjoining counties of Sauk and Columbia. The production of the Baraboo district in 1903 was a little less than 19,000 tons, but no ore was shipped. Shipments from this district began in 1904.

SHIPMENTS OF IRON ORE FROM NEW JERSEY MINES.

The shipments of iron ore from the mines in New Jersey were as follows from 1892 to 1903, inclusive:

Shipments of iron ore from New Jersey mines, 1892–1903.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1892	469,236	1896	262,070	1900	339,914
1893	828,028	1897	239,634	1901	419,762
1894	277,483	1898	269,771	1902	399,984
1895	285,417	1899	300,758	1903	472,490

SHIPMENTS OF IRON ORE FROM THE CORNWALL MINES.

The following table shows the shipments of iron ore, in long tons, by the Cornwall mines in Pennsylvania, from 1892 to 1903, inclusive:

Shipments of iron ore from Cornwall mines, 1892–1903.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1892	634,714	1896	463,059	1900	558,713
1893	439,705	1897	419,878	1901	747,012
1894	371,710	1898	584,342	1902	594,177
1895	614,598	1899	763,152	1903	401,469

SHIPMENTS OF IRON ORE FROM LEADING DISTRICTS.

The shipments of iron ore from some of the leading iron-ore districts of the country in the last three years were as follows:

Shipments of iron ore from some leading iron-ore districts in 1901, 1902, and 1903.

[Long tons.]

District.	1901.	1902.	1903.
Lake Superior mines of Michigan and Wisconsin	9,802,584	12,144,018	[a] 9,720,637
Vermilion and Mesabi mines of Minnesota	10,790,953	15,427,108	14,569,241
Missouri mines	94,374	65,645	57,477
Cornwall mines, Pennsylvania	747,012	594,177	401,469
New Jersey mines	419,762	399,984	472,490
Chateaugay mines, on Lake Champlain	70,025	83,688	65,707
Port Henry mines	167,642	365,437	373,565
Salisbury region, Connecticut	19,472	28,276	24,255
Alleghany County, Va	212,690	199,690	196,126
Cranberry mines, North Carolina	180	30,810	60,108
Tennessee Coal, Iron, and Railroad Co.'s Inman mines in Tennessee	26,304	4,948	24,347
The same company's mines in Alabama	1,415,723	1,276,969	1,302,207
Calhoun, Etowah, and Shelby counties, Ala. [a]	202,095	422,745	240,227
Total of the above districts	23,968,816	31,088,490	27,507,856

[a] Includes 17,918 tons of iron ore shipped from the Iron Ridge mine, in Wisconsin.

SHIPMENTS OF IRON ORE FROM CUBA.

In the calendar year 1903 only two companies shipped iron ore from Cuba, namely, the Juragua Iron Company (Limited) and the Spanish-American Iron Company, the shipments by the Juragua Company amounting to 157,230 long tons and the shipments by the Spanish-American Company amounting to 467,628 tons: total, 624,858 tons. Of the total shipments by the Spanish-American Company 456,826 tons were sent to the United States and 10,802 tons to England. All the shipments of the Juragua Company were made to the United States.

The total shipments of iron ore by companies from Cuba to all countries from the opening of the mines in 1884 to the close of 1903 were as follows, in long tons: The Juragua Iron Company (Limited) and the Juragua Iron Company, the latter company succeeding the former late in 1903, 4,069,025 tons; the Sigua Iron Company, 20,438 tons; the Spanish-American Iron Company, 2,244,746 tons; the Cuban Steel Ore Company, 41,241 tons: total shipments since 1884, 6,375,450 tons.

With the exception of 5,932 tons of iron ore shipped by the Juragua Iron Company (Limited) in 1897 to Pictou, Nova Scotia, and 51,537 tons shipped to foreign countries by the Spanish-American Iron Company in 1897, 4,200 tons shipped in 1899, 12,849 tons in 1901, and 10,802 tons in 1903, all the iron ore referred to above was shipped to the United States. The total shipments to foreign countries amounted to 85,320 tons, and the total shipments to the United States to 6,290,130 tons.

IMPORTS OF IRON ORE IN 1901, 1902, AND 1903.

The following table, furnished by the Bureau of Statistics of the Department of Commerce and Labor, gives the quantities and value of iron ore imported into the United States in the calendar years 1901, 1902, and 1903, by customs districts:

Imports of iron ore into United States in 1901, 1902, and 1903, by customs districts.

Customs district.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Baltimore	484,035	$783,071	600,711	$1,401,326	490,920	$1,232,546
New York	15,865	45,863	14,546	39,800	6,940	19,759
Philadelphia	298,255	459,698	338,848	597,895	303,722	560,880
Puget Sound	2,875	4,318	5,661	9,312	525	789
Vermont	48	186	18	72	760	1,190
All other	165,872	416,142	205,686	534,672	177,573	445,844
Total	966,950	1,659,278	1,165,470	2,583,077	980,440	2,261,008

The imports of iron ore in 1903 included 170,206 tons from Canada, valued at $425,129, received chiefly at Lake Erie ports. There were also imported in 1903 from Newfoundland into the customs district of Philadelphia 86,730 tons, valued at $86,680.

TOTAL IMPORTS OF IRON ORE SINCE 1879.

The following table gives the imports of iron ore into the United States in the calendar years 1879 to 1903, inclusive. 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 coming from that country in 1873, 1874, and 1875.

Total imports of iron ore into the United States, 1879–1903.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1879	284,141	1888	587,470	1897	489,970
1880	493,408	1889	853,573	1898	187,093
1881	782,887	1890	1,246,830	1899	674,082
1882	589,655	1891	912,856	1900	897,831
1883	490,875	1892	806,585	1901	966,950
1884	487,820	1893	526,951	1902	1,165,470
1885	390,786	1894	168,541	1903	980,440
1886	1,039,433	1895	524,153		
1887	1,194,301	1896	682,806		

IMPORTS OF MANGANESE ORE SINCE 1889.

The following table, furnished by the Bureau of Statistics of the Department of Commerce and Labor, gives the imports of manganese ore into the United States from 1889 to 1903, inclusive:

Imports of manganese ore into the United States, 1889–1903.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1889	4,286	1894	44,655	1899	188,349
1890	34,154	1895	86,111	1900	256,252
1891	28,825	1896	31,489	1901	165,722
1892	58,572	1897	119,961	1902	235,576
1893	68,113	1898	114,885	1903	146,056

The United States produces annually only a few thousand tons of manganese ore, but most of the iron ores of the United States contain varying percentages of manganese.

AVERAGE MONTHLY PRICES OF IRON AND STEEL.

In the following table are given the average monthly prices of leading articles of iron and steel in Pennsylvania in 1901, 1902, and 1903, and in the first ten months of 1904. The prices named are per long ton, except for bar iron, which is quoted by the 100 pounds from store at Philadelphia and from mills at Pittsburg, and for steel bars by the 100 pounds at Pittsburg mills:

Average monthly prices of iron and steel in Pennsylvania from January 1, 1901, to October 20, 1904, inclusive.

Year and month.	Old iron T rails, at Philadelphia.	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.	Steel rails, at mills, in Pennsylvania.	Steel billets, at mills, at Pittsburg.	Best refined bar iron, from store, Philadelphia.	Best refined bar iron, at mills, Pittsburg.	Bar steel, at mills, at Pittsburg.
	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.*	*Per 100 pounds.*
1901.										
January	$18.00	$16.05	$14.50	$13.25	$13.43	$26.00	$19.75	$1.75	$1.75	$1.20
February	18.25	16.00	14.19	13.56	14.60	26.00	20.31	1.75	1.82	1.27
March	18.37	16.00	14.00	14.62	16.87	26.00	22.87	1.75	1.90	1.44
April	19.50	16.00	14.37	14.56	16.94	26.00	24.00	1.85	1.90	1.50
May	19.50	16.00	14.30	14.62	16.70	28.00	24.00	1.85	1.90	1.50
June	19.12	16.00	14.06	14.15	16.00	28.00	24.37	1.85	1.86	1.50
July	19.00	15.87	13.87	14.00	16.00	28.00	24.00	1.85	1.75	1.52
August	19.00	15.50	13.75	13.87	16.00	28.00	24.20	1.85	1.75	1.50
September	18.50	15.50	13.75	13.81	16.00	28.00	24.87	1.85	1.75	1.50
October	19.90	15.50	13.75	14.10	16.00	28.00	26.70	1.90	1.75	1.52
November	21.25	15.75	13.94	14.69	16.31	28.00	27.00	1.90	1.75	1.60
December	21.50	16.25	14.44	15.12	16.37	28.00	27.50	1.90	1.75	1.60
1902.										
January	21.30	17.55	15.65	16.00	16.70	28.00	27.60	1.90	1.87	1.56
February	21.25	18.37	16.62	16.37	16.94	28.00	29.37	2.00	1.90	1.50
March	23.00	19.44	17.75	17.44	17.37	28.00	31.25	2.10	1.90	1.50
April	25.25	20.37	18.19	18.56	18.75	28.00	31.50	2.10	1.95	1.67
May	25.00	21.00	18.35	19.75	20.75	28.00	32.20	2.10	2.02	1.80
June	24.50	22.87	19.44	20.06	21.56	28.00	32.37	2.20	2.10	1.80
July	24.70	24.20	20.80	21.00	21.60	28.00	31.75	2.20	1.86	1.72
August	24.00	24.50	21.00	20.69	22.19	28.00	31.75	2.20	1.95	1.75
September	24.25	24.50	20.50	20.81	22.50	28.00	31.00	2.20	2.00	1.75
October	24.80	24.45	20.25	21.60	23.00	28.00	30.40	2.20	1.92	1.69
November	24.25	24.87	20.94	21.06	23.81	28.00	28.50	2.20	1.85	1.60
December	23.62	24.20	20.90	20.55	22.92	28.00	29.20	2.20	2.00	1.68
1903.										
January	23.50	24.00	20.50	20.50	22.85	28.00	29.60	2.20	2.00	1.64
February	23.75	23.75	20.00	20.50	21.91	28.00	30.00	2.20	2.00	1.60
March	24.50	23.50	19.50	20.87	21.85	28.00	30.62	2.20	2.00	1.60
April	24.90	22.70	19.10	20.45	21.28	28.00	30.20	2.20	2.00	1.60
May	24.50	21.37	18.62	19.87	20.01	28.00	30.25	2.16	2.00	1.60
June	23.50	20.62	18.00	18.87	19.72	28.00	28.87	2.08	1.77	1.60
July	22.00	19.00	17.50	17.90	18.93	28.00	27.40	2.01	1.70	1.60
August	19.37	18.00	15.81	16.04	18.35	28.00	27.00	1.93	1.70	1.60
September	18.75	17.50	14.94	15.25	17.22	28.00	27.00	1.81	1.70	1.60

Average montly prices of iron and steel in Pennsylvania from January 1, 1901, to October 20, 1904, inclusive—Continued.

Year and month.	Old iron T rails, at Philadelphia.	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.	Steel rails, at mills, in Pennsylvania.	Steel billets, at mills, at Pittsburg	Best refined bar iron, from store, Philadelphia.	Best refined bar iron, at mills, Pittsburg.	Bar steel, at mills, at Pittsburg.
	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.*	*Per 100 pounds.*
1903.										
October	17.50	16.70	14.05	14.20	16.00	28.00	27.00	1.81	1.70	1.60
November	16.37	16.00	13.75	13.00	15.19	28.00	24.00	1.71	1.34	1.37
December	15.40	15.85	13.75	12.80	14.40	28.00	23.00	1.71	1.30	1.30
1904.										
January	15.87	15.50	13.50	12.81	13.90	28.00	23.00	1.71	1.30	1.30
February	15.00	15.50	13.50	12.75	13.66	28.00	23.00	1.71	1.31	1.30
March	16.70	15.45	13.50	13.17	14.03	28.00	23.00	1.71	1.38	1.33
April	18.37	15.75	13.75	13.09	14.19	28.00	23.00	1.71	1.50	1.35
May	15.85	15.40	13.55	12.62	13.60	28.00	23.00	1.71	1.50	1.32
June	14.50	15.19	13.31	12.27	12.81	28.00	23.00	1.71	1.50	1.30
July	14.12	14.94	13.12	11.92	12.46	28.00	23.00	1.71	1.50	1.30
August	14.55	15.00	13.00	11.89	12.76	28.00	23.00	1.71	1.50	1.31
September	15.50	15.00	12.87	11.75	12.69	28.00	21.25	1.71	1.50	1.33
October 20	16.00	15.00	13.00	12.12	12.93	28.00	19.50	1.71	1.50	1.30

AVERAGE YEARLY PRICES OF IRON AND STEEL.

The following table gives the average yearly prices of leading articles of iron and steel in Pennsylvania and of wire nails at Chicago from 1899 to 1903. These prices are obtained by averaging monthly quotations, which have in turn been averaged from weekly quotations. The prices given are per ton of 2,240 pounds, except for bar iron and bar steel and cut and wire nails, which are quoted by the 100 pounds and in 100-pound kegs, respectively.

Average yearly prices of iron and steel, 1899–1903.

Article.	1899.	1900.	1901.	1902.	1903.
Old iron T-rails, at Philadelphia	$20.36	$19.51	$19.32	$23.83	$21.17
No. 1 foundry pig iron, at Philadelphia	19.36	19.98	15.87	22.19	19.92
Gray forge pig iron, at Philadelphia	16.60	16.49	14.08	19.20	17.13
Gray forge pig iron, at Pittsburg	16.72	16.90	14.20	19.49	17.52
Bessemer pig iron, at Pittsburg	19.03	19.49	15.93	20.67	18.98
Steel rails, at mills, in Pennsylvania	28.12	32.29	27.33	28.00	28.00
Steel billets, at mills, at Pittsburg	31.12	25.06	24.13	30.57	27.91
Best bar iron, from store, at Philadelphia	2.07	1.96	1.84	2.13	2.00
Best bar iron, at mills, at Pittsburg	1.95	2.15	1.80	1.94	1.77
Steel bars, at mills, at Pittsburg	1.93	1.63	1.47	1.67	1.56
Cut nails, from store, at Philadelphia	2.21	2.46	2.29	2.29	2.36
Wire nails, base price, at Chicago	2.60	2.76	2.41	2.15	2.13

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 1897 to 1903:

Average monthly prices of steel bars at Pittsburg, Pa., per 100 pounds, 1897–1903.

Month.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	$1.07	$1.00	$1.07	$2.25	$1.20	$1.58	$1.64
February	1.05	1.00	1.09	2.25	1.27	1.50	1.60
March	1.00	.99	1.48	2.25	1.44	1.50	1.60
April	.96	.96	1.75	2.12	1.50	1.67	1.60
May	.92	.95	1.71	1.94	1.50	1.80	1.60
June	.90	.95	2.05	1.79	1.50	1.80	1.60
July	.90	.95	2.00	1.24	1.52	1.72	1.60
August	.90	.96	2.21	1.05	1.50	1.75	1.60
September	1.00	.99	2.50	1.12	1.50	1.75	1.60
October	1.00	1.00	2.60	1.15	1.52	1.69	1.60
November	1.00	1.01	2.46	1.18	1.60	1.60	1.37
December	1.00	1.00	2.25	1.20	1.60	1.68	1.30
Average	.97	.98	1.93	1.63	1.47	1.67	1.56

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 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 1896, as reported to us by the Duncannon Iron Company:

Average monthly prices of cut nails at Philadelphia, from store, 1896–1903.

[Per keg of 100 pounds.]

Month.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	$2.30	$1.60	$1.35	$1.40	$2.80	$2.25	$2.30	$2.33
February	2.30	1.55	1.35	1.65	2.80	2.27	2.20	2.36
March	2.45	1.55	1.30	1.75	2.80	2.27	2.25	2.36
April	2.45	1.50	1.30	1.95	2.62	2.30	2.30	2.41
May	2.45	1.45	1.30	1.95	2.45	2.30	2.30	2.41
June	2.53	1.45	1.30	2.20	2.42	2.30	2.30	2.41
July	2.53	1.40	1.30	2.30	2.30	2.30	2.30	2.41
August	2.53	1.40	1.30	2.35	2.30	2.30	2.30	2.41
September	2.53	1.45	1.30	2.60	2.25	2.35	2.30	2.41
October	2.53	1.45	1.30	2.75	2.28	2.30	2.30	2.41
November	2.00	1.40	1.30	2.80	2.30	2.30	2.30	2.20
December	a1.70	1.40	1.30	2.80	2.25	2.30	2.30	2.20
Average	2.36	1.47	1.31	2.21	2.46	2.29	2.29	2.36

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 wire-nail schedule referred to on the following page.

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, in the eight years from 1896 to 1903, inclusive:

Average monthly base prices of standard sizes of wire nails at Chicago, 1896–1903.

[Per keg of 100 pounds.]

Month.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	$2.42	$1.50	$1.55	$1.59	$3.53	$2.35	$2.16	$2.08
February	2.42	1.45	1.57	1.73	3.53	2.45	2.20	2.12
March	2.57	1.50	1.55	2.09	3.58	2.45	2.20	2.20
April	2.55	1.45	1.47	2.25	3.28	2.45	2.20	2.15
May	2.70	1.42	1.45	2.35	2.53	2.45	2.20	2.15
June	2.70	1.42	1.43	2.60	2.48	2.45	2.20	2.15
July	2.70	1.35	1.36	2.70	2.48	2.45	2.20	2.15
August	2.70	1.37	1.36	2.80	2.48	2.45	2.20	2.15
September	2.70	1.50	1.45	3.10	2.35	2.45	2.15	2.15
October	2.70	1.52	1.47	3.20	2.35	2.42	2.05	2.15
November	2.70	1.50	1.40	3.28	2.35	2.35	2.00	2.15
December	a 1.60	1.50	1.37	3.58	2.35	2.25	2.00	2.00
Average	2.54	1.46	1.45	2.60	2.76	2.41	2.15	2.13

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 WHOLESALE MONTHLY PRICES OF TIN PLATES.

In late years foreign tin plates have not been an important factor in supplying the home market. The prices of foreign tin plates 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 1, 1901, to October 20, 1904, inclusive:

Average wholesale monthly prices of tin plates at mills in Pennsylvania from January 1, 1901, to October 20, 1904, inclusive.

[Per box of 100 pounds.]

Month.	Price.	Month.	Price.	Month.	Price.	Month.	Price.
1901.		1902.		1903.		1904.	
January	$4.00	January	$4.00	January	$3.60	January	$3.56
February	4.00	February	4.00	February	3.60	February	3.45
March	4.00	March	4.00	March	3.80	March	3.45
April	4.00	April	4.00	April	3.80	April	3.45
May	4.00	May	4.00	May	3.80	May	3.45
June	4.00	June	4.00	June	3.80	June	3.45
July	4.00	July	4.00	July	3.80	July	3.41
August	4.00	August	4.00	August	3.80	August	3.30
September	4.00	September	4.00	September	3.80	September	3.30
October	4.00	October	4.00	October	3.80	October 20	3.30
November	4.00	November	3.60	November	3.65	November	....
December	4.00	December	3.60	December	3.60	December	....
Average	4.00	Average	3.93	Average	3.74	Average	....

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

AVERAGE YEARLY PRICES OF FOREIGN TIN PLATES.

The following table gives the average yearly prices of imported coke Bessemer tin plates, I. C., 14 by 20, per box of 108 pounds, at New York, freight and duty paid, from 1890 to 1898:

Average yearly prices of imported tin plates at New York, 1890–1898.

Year.	Price.	Year.	Price.	Year.	Price.
1890	$4.80	1893	$5.37	1896	$3.80
1891	5.34	1894	4.89	1897	3.90
1892	5.30	1895	3.87	1898	4.00

AVERAGE YEARLY PRICES OF DOMESTIC TIN PLATES.

The following table gives the average yearly prices of domestic Bessemer tin plates, I. C., 14 by 20, per box of 100 pounds, at mills in Pennsylvania, from 1899 to 1903, with the price in October, 1904:

Average yearly prices of domestic tin plates at mills in Pennsylvania from 1899 to October 20, 1904, inclusive.

[Per box of 100 pounds.]

Year.	Price.	Year.	Price.	Year.	Price.
1899	$4.06	1901	$4.00	1903	$3.74
1900	4.47	1902	3.93	1904 (October 20)	3.30

PRICES OF STEEL SHIP PLATES AT PITTSBURG.

The following table gives the average monthly prices of steel ship plates free on board at Pittsburg from October 1, 1900, to September 30, 1904. On September 6, 1904, the price was reduced from 1.6 cents per pound to 1.4 cents, or from $35.84 to $31.36 per ton.

Average monthly prices of steel ship plates at Pittsburg, Pa., from October 1, 1900, to September 30, 1904, inclusive.

[Per long ton.]

Month.	Price.	Month.	Price.	Month.	Price.
1900.		1902.		1903.	
October	$24.64	February	$35.84	July	$35.84
November	28.00	March	35.84	August	35.84
December	30.24	April	35.84	September	35.84
1901.		May	35.84	October	35.84
January	31.36	June	35.84	November	35.84
February	31.36	July	35.84	December	35.84
March	33.15	August	35.84	1904.	
April	35.84	September	35.84	January	35.84
May	35.84	October	35.84	February	35.84
June	35.84	November	35.84	March	35.84
July	35.84	December	35.84	April	35.84
August	35.84	1903.		May	35.84
September	35.84	January	35.84	June	35.84
October	35.84	February	35.84	July	35.84
November	35.84	March	35.84	August	35.84
December	35.84	April	35.84	September	32.48
1902.		May	35.84		
January	35.84	June	35.84		

AVERAGE QUARTERLY PRICES OF BEAMS AND CHANNELS.

The following table, which gives the average quarterly prices of steel beams and channels at Pittsburg, Pa., from 1894 to 1904, has been compiled for this report by one of the leading manufacturers of structural shapes in western Pennsylvania:

Average quarterly prices of beams and channels at Pittsburg, Pa., 1894–1904.

[Price per 100 pounds.]

Year.	First quarter.	Second quarter.	Third quarter.	Fourth quarter.	Average.	Year.	First quarter.	Second quarter.	Third quarter.	Fourth quarter.	Average.
1894.....	$1.21	$1.20	$1.27	$1.25	$1.23	1900.....	$2.25	$2.21	$1.68	$1.50	$1.91
1895.....	1.21	1.25	1.56	1.58	1.40	1901.....	1.51	1.60	1.60	1.60	1.58
1896.....	1.44	1.49	1.55	1.50	1.49	1902.....	1.60	1.60	1.60	1.60	1.60
1897.....	1.55	1.33	.98	1.09	1.24	1903.....	1.60	1.60	1.60	1.60	1.60
1898.....	1.15	1.15	1.19	1.20	1.17	1904.....	1.60	1.60	1.45	....	....
1899.....	1.35	1.60	2.12	2.25	1.83						

During the period covered by this table the lowest average quarterly price for beams and channels was in the third quarter of 1897, when the ruling price was 98 cents per 100 pounds, or less than 1 cent per pound. The highest average quarterly price was in the last quarter of 1899 and the first quarter of 1900, when the price was $2.25 per 100 pounds.

PRICES OF LAKE SUPERIOR IRON ORE.

The following table gives the prices at which Lake Superior iron ore has been sold upon season contracts in 1902 and 1903, per long ton, delivered at lower ports on Lake Erie; also the prices at which sales were made in the spring of 1904 for season delivery. These prices have been furnished by Mr. A. I. Findley, the editor of the Iron Trade Review.

Prices of Lake Superior iron ore, 1902–1904.

[Per long ton.]

Grade.	1902.	1903.	1904.
Mesabi Bessemer	$3.00 @ $3.25	a $4.00	$2.75 @ $3.00
Mesabi non-Bessemer	2.60 @ 2.85	a 3.20	2.35 @ 2.50
Marquette specular No. 1 Bessemer	4.65 @ 5.00	4.85 @ 5.15	3.60 @ 3.85
Marquette specular No. 1 non-Bessemer	3.80 @ 4.00	4.00 @ 4.25	3.10 @ 3.35
Chapin	3.91		
Soft hematites, No. 1 non-Bessemer	3.00 @ 3.25	a 3.60	2.60 @ 2.80
Gogebic, Marquette, and Menominee No. 1 Bessemer hematites	4.25 @ 4.65	a 4.50	3.00 @ 3.25
Vermilion No. 1 hard non-Bessemer	4.07		
Chandler No. 1 Bessemer	4.50		
Marquette extra low-phosphorus Bessemer	5.40		

a Prices for base ores.

Quotations have been omitted for 1903 and 1904 for Chapin, Vermilion No. 1 hard non-Bessemer, Chandler No. 1 Bessemer, and Marquette extra low-phosphorus Bessemer ores because none of these are now on the market, these ores being mined for their own use by the United States Steel Corporation and other companies which own the mines from which they are obtained. For the first time since 1894 the Lake Superior iron-ore market became an open one for 1904 shipments.

TOTAL PRODUCTION OF PIG IRON.

High-water mark in the production of pig iron in the United States was reached in 1903, notwithstanding the reaction in the latter part of that year from the active demand for iron and steel that had prevailed in immediately preceding years.

Twenty-two States made pig iron in 1903, against 22 in 1902, 20 in 1901, and 21 in 1900 and 1899. The total production of pig iron in

1903 was 18,009,252 long tons, against 17,821,307 tons in 1902, 15,878,354 tons in 1901, 13,789,242 tons in 1900, 13,620,703 tons in 1899, and 11,773,934 tons in 1898. The production in 1903 was 187,945 tons in excess of that in 1902, but the production in the second half of 1903 was 1,405,482 tons less than in the first half. The production in the first half was, however, much the largest in our history. The following table gives the half-yearly production of pig iron in the last six years:

Production of pig iron in the United States, 1898–1903, by half-years.

[Long tons.]

Period.	1898.	1899.	1900.	1901.	1902.	1903.
First half	5,869,703	6,289,167	7,642,569	7,674,613	8,808,574	9,707,367
Second half	5,904,231	7,331,536	6,146,673	8,203,741	9,012,733	8,301,885
Total	11,773,934	13,620,703	13,789,242	15,878,354	17,821,307	18,009,252

The following table gives the production of pig iron, by States, in 1902 and 1903, in the order of their prominence in 1903:

Production of pig iron in 1902 and 1903, by States.

[Long tons.]

State.	1902.	1903.	State.	1902.	1903.
Pennsylvania	8,117,800	8,211,500	Michigan	155,213	244,709
Ohio	3,631,388	3,287,434	New Jersey	191,380	211,667
Illinois	1,730,220	1,692,375	West Virginia	183,005	199,013
Alabama	1,472,211	1,561,398	Kentucky	110,725	102,441
New York	401,369	552,917	North Carolina and Georgia	32,315	75,602
Virginia	537,216	544,034	Connecticut	12,086	14,501
Tennessee	392,778	418,368	Texas	3,095	11,653
Maryland	308,229	324,570	Massachusetts	3,360	3,265
Wisconsin and Minnesota	273,967	283,516			
Missouri, Colorado, and Washington	269,930	270,289	Total	17,821,307	18,009,252

PRODUCTION OF PIG IRON ACCORDING TO FUEL USED.

The production of pig iron in 1903, classified according to the fuel used, was as follows, compared with the four preceding years:

Production of pig iron according to fuel used, 1899–1903.

[Long tons.]

Fuel used.	1899.	1900.	1901.	1902.	1903.
Bituminous, chiefly coke	11,736,385	11,727,712	13,782,386	16,315,891	15,592,221
Anthracite and coke	1,558,521	1,636,366	1,668,808	1,096,040	1,864,199
Anthracite alone	41,031	40,682	43,719	19,207	47,148
Charcoal	284,766	339,874	360,147	378,504	504,757
Charcoal and coke	....	44,608	23,294	11,665	927
Total	13,620,703	13,789,242	15,878,354	17,821,307	18,009,252

PRODUCTION OF BESSEMER PIG IRON.

The following table gives the production of Bessemer pig iron, by States, in each year from 1898 to 1903, in long tons. Bessemer pig iron made with charcoal is included. Low-phosphorus pig iron is included in the statistics for 1901, 1902, and 1903.

Production of Bessemer pig iron in 1898–1903, by States.

[Long tons.]

State.	1898.	1899.	1900.	1901.	1902.	1903.
Pennsylvania	4,040,965	4,473,493	4,242,397	4,885,877	5,130,022	5,213,143
Ohio	1,570,535	1,852,965	1,898,663	2,637,091	2,927,605	2,422,676
Illinois	1,210,124	1,330,169	1,178,241	1,394,430	1,495,298	1,386,683
Maryland	186,563	210,670	260,688	297,149	296,971	321,784
West Virginia	192,699	187,858	169,802	166,597	182,937	198,688
North Carolina	....	....				....
Colorado	88.701	96,364	118,146	147,216	201,580	176,116
Missouri	30,238					
Kentucky and Tennessee	....	22,756	13,430	a	9,746	26,856
Wisconsin	14,620					
Michigan	2,939	14,519	21,785	39,941	82,328	111,340
Minnnsota	....					
New Jersey	....	13,984	40,300	28,492	66,681	129,323
New York	....	....				
Virginia and Alabama	....	....	....	....	....	3,299
Total	7,337,384	8,202,778	7,943,452	9,596,793	10,393,168	9,989,908

Of the production of Bessemer and low-phosphorus pig iron in Pennsylvania in 1903 the Lehigh Valley made 106,184 tons; the Schuylkill Valley, 77,882 tons; the lower Susquehanna Valley, 368,745 tons; Allegheny County, 3,276,850 tons; the Shenango Valley, 806,708 tons, and the remainder of the State, 576,774 tons: total, 5,213,143 tons.

In Ohio in 1903 the Mahoning Valley produced 872,758 tons of Bessemer and low-phosphorus pig iron; the Hanging Rock bituminous district, 100,972 tons; the Lake counties, 715,608 tons; and other parts of Ohio, 733,338 tons: total, 2,422,676 tons.

PRODUCTION OF BESSEMER PIG IRON SINCE 1887.

The production of Bessemer pig iron in the United States was not collected separately from that of other kinds of pig iron until 1887. Since that year it has been as follows:

Production of Bessemer pig iron in the United States, 1887–1903.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1887	2,875,462	1893	3,568,598	1899	8,202,778
1888	2,637,859	1894	3,808,567	1900	7,943,452
1889	3,151,414	1895	5,623,695	1901	9,596,793
1890	4,092,343	1896	4,654,955	1902	10,393,168
1891	3,472,190	1897	5,795,584	1903	9,989,908
1892	4,444,041	1898	7,337,384		

PRODUCTION OF BASIC PIG IRON.

The production of basic pig iron in 1896, with coke or mixed anthracite and coke as fuel, 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; in 1902 it was 2,038,590 tons, and in 1903 it was 2,040,726 tons. Basic charcoal pig iron is not included in these figures. The production of basic pig iron, by States, since 1899 is given in the following table:

Production of basic pig iron, 1899–1903, by States.

[Long tons.]

State.	1899.	1900.	1901.	1902.	1903.
New York and New Jersey	....	4,929	34,320	90,736	117,802
Pennsylvania—Allegheny County	470,848	446,543	568,516	982,532	791,175
Pennsylvania—Other counties	267,760	344,065	442,744	596,216	626,078
Maryland, Virginia, Tennessee, and Alabama	166,093	179,717	301,444	295,191	267,999
Ohio, Illinois, Wisconsin, Missouri, and Colorado	80,332	97,122	101,826	123,915	237,672
Total	985,033	1,072,376	1,448,850	2,038,590	2,040,726

Maryland, Tennessee, Illinois, and Wisconsin did not make basic pig iron in 1901 or 1902, as in some previous years, and Maryland, Illinois, and Wisconsin did not make any in 1903, while Colorado for the first time made basic pig iron in 1903.

PRODUCTION OF SPIEGELEISEN AND FERROMANGANESE.

The production of spiegeleisen and ferromanganese in 1903, included in the total production of pig iron, was 192,661 tons, against 212,981 tons in 1902, 291,461 tons in 1901, 255,977 tons in 1900, 219,768 tons in 1899, 213,769 tons in 1898, 173,695 tons in 1897, 131,940 tons in 1896, 171,724 tons in 1895, 120,180 tons in 1894, and 81,118 tons in 1893. The spiegeleisen and ferromanganese produced in 1903 were made in New Jersey, Pennsylvania, Alabama, Illinois, and Colorado. In the total for 1902 is a small quantity of ferrophosphorus, made in Alabama.

The production by States in 1901, 1902, and 1903, of speigeleisen and ferromanganese was as follows:

Production of spiegeleisen and ferromanganese in 1901, 1902, and 1903, by States.

[Long tons.]

State.	Spiegeleisen.			Ferromanganese.		
	1901.	1902.	1903.	1901.	1902.	1903.
New Jersey	28,789	14,182	15,346	....	....	....
Pennsylvania	133,986	99,333	76,493	57,408	44,453	34,871
Alabama	302	475	24	2,049	120	1,090
Illinois	60,297	45,801	57,955	182	....	....
Colorado	8,448	8,567	6,882	....	....	....
Total	231,822	168,408	156,700	59,639	44,573	35,961

The figures given for ferromanganese for 1902 include a small quantity of ferrophosphorus made in one of the Southern States. Ferrophosphorous was not reported to us for 1903. As a rule, spiegeleisen contains from 9 to 22 per cent of manganese, and ferromanganese from 45 to 82 per cent. The standard for spiegeleisen is 20 per cent and for ferromanganese 80 per cent.

PRODUCTION OF PIG IRON BY GRADES.

The following table gives the total production of pig iron in the United States in 1901, 1902, and 1903, by grades:

Production of pig iron in 1901, 1902, and 1903, by grades.

[Long tons.]

Grade.	1901.	1902.	1903.
Bessemer and low-phosphorus pig iron	9,596,793	10,393,168	9,989,908
Basic pig iron made with mineral fuel	1,448,850	2 038,590	2,040,726
Forge pig iron	639,454	833,093	783,016
Foundry and high silicon pig iron	3,548,718	3,851,276	4,409,023
Malleable Bessemer pig iron	256,532	311,458	473,781
White and mottled and miscellanous	87,964	172,085	120,137
Spiegeleisen	231,822	168,408	156,700
Ferromanganese	59,639	44,573	35,961
Direct castings	8,532	8,656	....
Total	15,878,354	17,821,307	18,009,252

The Bessemer figures include low-phosphorus pig iron—that is, iron running below 0.04 per cent in phosphorus. Pig iron containing from 0.04 to 0.10 per cent of phosphorus is classified as Bessemer. The basic figures are confined strictly to pig iron made with mineral fuel, and do not include the small quantity of basic iron that is annually made with charcoal, practically all of which is used by manufacturers of steel castings. A few thousand tons of castings direct from the furnace are included in the totals for white and mottled and miscellaneous grades of pig iron for 1903. Ferrosilicon and high silicon pig iron are included in the foundry figures.

Of the total production of pig iron in 1903 over 55.4 per cent was Bessemer and low-phosphorus, as compared with over 58 per cent in 1902; 24.4 per cent was foundry, against 21.6 per cent in 1902; over 11.3 per cent was basic, against 11.4 per cent in 1902; 4.3 per cent was forge, against 4.6 per cent in 1902; 1.06 per cent was spiegeleisen and ferromanganese, against 1.19 per cent in 1902; and 2.6 per cent was malleable Bessemer, against 1.7 per cent in 1902. The production of white and mottled and miscellaneous grades of pig iron and of castings made direct from the furnace amounted to a little over 1 per cent in 1902, and to less than 1 per cent in 1903.

In 1903 the production of low-phosphorus pig iron amounted to 200,422 tons, against 164,246 tons in 1902. In 1903 low-phosphorus pig iron was made in New York, Pennsylvania, Tennessee, and Ohio.

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 1903, and were not intended for their own consumption, amounted to 591,438 tons, against 49,951 tons at the close of 1902, 70,647 tons at the close of 1901, and 442,370 tons at the close of 1900. Warrant stocks not controlled by the makers are not included.

The American Pig Iron Storage Warrant Company held in its yards on December 31, 1903, 47,200 tons of pig iron. On December 31, 1902, the company had no pig iron stored in any of its yards. At the end of 1901 it had 3,000 tons in its yards, and at the end of 1900 it had 16,400 tons.

NUMBER OF COMPLETED FURNACES.

The whole number of completed furnaces in the United States at the close of 1903 was 425, against 412 at the close of 1902 and 406 at the close of 1901. The following table shows the number of completed furnaces at the end of each year since 1898, not counting abandoned furnaces in any year:

Number of completed furnaces, 1898–1903, according to fuel used.

Fuel used.	1898.	1899.	1900.	1901.	1902.	1903.
Bituminous coal and coke	242	235	240	257	272	288
Anthracite and anthracite and coke	94	99	94	90	81	77
Charcoal and charcoal and coke	78	80	72	59	59	60
Total	414	414	406	406	412	425

NUMBER OF FURNACES IN BLAST.

The whole number of furnaces which were in blast at the close of 1903 was 182, against 307 at the close of 1902 and 266 at the close of 1901. The following classified table shows the number of furnaces in blast at the close of each year since 1898:

Number of furnaces in blast, 1898–1903, according to fuel used.

Fuel used.	1898.	1899.	1900.	1901.	1902.	1903.
Bituminous coal and coke	152	191	155	188	222	120
Anthracite and anthracite and coke	30	68	45	54	52	29
Charcoal and charcoal and coke	20	30	32	24	33	33
Total	202	289	232	266	307	182

The number of furnaces out of blast at the close of 1903 was 243. Some of these furnaces were only temporarily banked.

PRODUCTION OF PIG IRON IN THE FIRST HALF OF 1904.

The production of pig iron in the first half of 1904 was 8,173,438 long tons, against 8,301,885 tons in the last half of 1903 and 9,707,367 tons in the first half of 1903. The decrease in production in the first half of 1904 as compared with the second half of 1903 amounted to only 128,447 tons, but as compared with the first half of 1903 it amounted to 1,533,929 tons. And yet the production in the first half of 1904 was greater than in any half year prior to the second half of 1901.

The production of Bessemer pig iron in the first half of 1904 was 4,530,946 long tons, against 4,509,289 tons in the last half of 1903 and

5,480,619 tons in the first half of 1903. The figures for the first half of 1904 include 87,582 tons of low-phosphorus pig iron, against 110,699 tons in the last half of 1903 and 89,723 tons in the first half of that year.

The production of basic pig iron in the first half of 1904 was 1,061,901 long tons, against 836,923 tons in the last half of 1903 and 1,203,803 tons in the first half of 1903. Basic pig iron made with charcoal is not included in these figures.

The production of charcoal pig iron in the first half of 1904 was 213,356 long tons, against 272,040 tons in the last half of 1903 and 232,717 tons in the first half of 1903. In addition there were produced in Wisconsin and Washington 927 tons of mixed charcoal and coke pig iron in the first six months of 1903. No pig iron has been made with this fuel since the first half of 1903.

The production of spiegeleisen and ferromanganese in the first half of 1904 was 114,206 long tons, against 81,986 tons in the last half of 1903 and 110,675 tons in the first half of 1903. The production of ferromanganese alone in the first half of 1904 amounted to 26,541 tons, against 14,118 tons in the last half of 1903 and 21,843 tons in the first half of that year. In addition to the above, Tennessee made 304 tons of ferrophosphorus in the first half of 1904.

The production of bituminous coal and coke pig iron in the first six months of 1904 amounted to 7,337,279 long tons, of anthracite and coke mixed to 607,624 tons, of anthracite alone to 15,179 tons, and of charcoal to 213,356 tons. Included in the bituminous figures is a small quantity of ferrosilicon made with electricity.

The stocks of pig iron which were unsold in the hands of manufacturers or their agents or were under their control in warrant yards or elsewhere on June 30, 1904, amounted to 623,254 tons, against 126,301 tons on June 30, 1903.

On June 30, 1904, the American Pig Iron Storage Warrant Company had 78,600 tons of iron stored in its various yards, virtually all of which was controlled by the makers, and all of which was included in the 623,254 tons of unsold iron reported on that date.

The whole number of furnaces in blast on June 30, 1904, was 216, against 320 on June 30, 1903, and 286 on June 30, 1902. The number of furnaces idle on June 30, 1904, was 209. Of the active furnaces on June 30, 1904, 170 used bituminous fuel, 26 used anthracite coal and coke mixed, 2 used anthracite coal alone, and 18 used charcoal alone.

ANNUAL CONSUMPTION OF PIG IRON.

Our 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 has not been considered. Warrant stocks not controlled by the makers are included in unsold stocks for each year.

Annual consumption of pig iron in the United States, 1899–1903.

[Long tons.]

Pig iron.	1899.	1900.	1901.	1902.	1903.
Domestic production	13,620,703	13,789,242	15,878,354	17,821,307	18,009,252
Imported	40,393	52,565	62,930	619,354	599,574
Stocks unsold Jan. 1	415,333	68,309	446,020	73,647	49,951
Total supply	14,076,429	13,910,116	16,387,304	18,514,308	18,658,777
Deduct stocks Dec. 31	68,309	446,020	73,647	49,951	598,489
Also exports	228,678	286,687	81,211	27,487	20,379
Approximate consumption	13,779,442	13,177,409	16,232,446	18,436,870	18,039,909

It will be observed that, although the production of pig iron in 1903 exceeded that of 1902 by 187,945 tons, the consumption in 1903 was 396,961 tons less than in 1902. Of course these figures are only an approximation to absolute accuracy.

LIMESTONE CONSUMED IN MAKING PIG IRON.

The limestone consumed for fluxing purposes by the blast furnaces of the United States in the production of 18,009,252 tons of pig iron in 1903 amounted to 9,591,760 tons. The average consumption of limestone per ton of all kinds of pig iron produced was 1,193 pounds in 1903, against 1,192.8 pounds in 1902, 1,186.5 pounds in 1901, and 1,205.6 pounds in 1900. The consumption in 1903 by the anthracite and bituminous furnaces was 1,207.3 pounds per ton of pig iron made, and by the charcoal and mixed charcoal and coke furnaces it was 695.5 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.

The total production of Bessemer steel ingots and castings in the United States in 1903 was 8,592,829 long tons, against 9,138,363 tons in 1902, a decrease of 545,534 tons, or 5.9 per cent. The following table gives the production of Bessemer steel ingots and castings in the last five years by States. Of the 1903 production 18,099 tons were steel castings, against a similar production of 12,548 tons in 1902.

Production of Bessemer steel in the United States, 1899–1903, by States.

[Long tons.]

State.	1899.	1900.	1901.	1902.	1903.
Pennsylvania	3,968,779	3,488,731	4,293,439	4,209,326	3,909,436
Ohio	1,679,237	1,388,124	2,154,846	2,528,802	2,330,134
Illinois	1,211,246	1,115,571	1,324,217	1,443,614	1,366,569
Other States	727,092	692,344	940,800	956,621	986,690
Total	7,586,354	6,684,770	8,713,302	9,138,363	8,592,829

There were no Clapp-Griffiths works in operation in 1903, and only 2 Robert-Bessemer plants were active. Eight Tropenas plants were at work, as compared with 5 in 1902. In addition 1 plant made steel by the Bookwalter process and 1 plant on the Pacific coast made a small quantity of steel in a special surface-blown converter. One plant also made steel by the Evans-Wills process. All these works produced steel castings only.

During 1903 the Lackawanna Steel Company completed the Bessemer department of its new plant at Lackawanna, N. Y. This department is equipped with four 10-long-ton converters, which have an annual capacity of 845,000 long tons of ingots. Steel ingots were first produced on October 13, 1903. The International Harvester Company also completed its new Bessemer steel plant at South Chicago in 1903. It is equipped with two 10-long-ton converters, with an annual capacity of 500,000 tons of ingots. Steel was first made on September 3, 1903.

The following plants, which are equipped to make steel castings by the Tropenas and other modifications of the Bessemer process, were completed and put in operation in 1903: Isaac G. Johnson & Co., Incorporated, Spuyten Duyvil, New York City, one 2-long-ton Tropenas converter; Naval Gun Factory, United States Navy-Yard, Washington, D. C., one 2-long-ton Tropenas converter; Newport News Shipbuilding and Dry Dock Company, Newport News, Va., one 2-long-ton Tropenas converter; and the Columbia Engineering Works, Incorporated, Portland, Oreg., one 2-long-ton surface-blown converter.

Since the close of 1903 the following plants have installed or are now installing Tropenas or other "little Bessemer" converters: Watertown Arsenal, Watertown, Mass., one 2-long-ton Tropenas converter; Providence Steel Casting Company, Providence, R. I., two 2-long-ton Tropenas converters; Southern Steel Works, Chattanooga, Tenn., one 2-long-ton Tropenas converter; and the Milwaukee Steel Foundry Company, Milwaukee, Wis., one 1-long-ton special steel converter.

In 1902 a plant for the manufacture of steel castings by the Evans-Wills process, which is a modification of the Bessemer process, was erected at Rahway, N. J. Its first castings were made on October 18, 1902. The plant is now equipped with two 4,000-pound converters. Steel castings by this process were made in 1903, but an open-hearth furnace has been added in 1904.

PRODUCTION OF OPEN-HEARTH STEEL.

The total production of open-hearth steel ingots and direct castings in the United States in 1903 was 5,829,911 long tons, against 5,687,729 tons in 1902, an increase of 142,182 tons, or 2.4 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 1903 of 3,599,619 tons, or over 161 per cent. The following table gives the production of open-hearth steel ingots and castings, by States, since 1898:

Production of open-hearth steel in the United States, 1898–1903, by States.

[Long tons.]

State.	1898.	1899.	1900.	1901.	1902.	1903.
New England	47,381	57,124	74,522	170,876	179,923	169,209
New York and New Jersey	47,957	61,461	67,361	82,985	92,763	104,598
Pennsylvania	1,817,521	2,393,811	2,699,502	3,594,763	4,375,364	4,442,730
Ohio	79,886	117,458	130,191	184,943	278,854	369,349
Illinois	183,103	246,183	285,551	398,522	435,461	422,919
Other States	54,444	71,279	141,008	224,220	325,364	321,106
Total	2,230,292	2,947,316	3,398,135	4,656,309	5,687,729	5,829,911

The open-hearth steel made in 1903 was produced by 111 works in 17 States: Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Delaware, Maryland, Tennessee, Alabama, Ohio, Indiana, Illinois, Wisconsin, Missouri, Colorado, and California. Ninety-eight works in 16 States made open-hearth steel in 1902. The States which have open-hearth furnaces, but which did not produce open-hearth steel in 1903, were West Virginia and Kentucky.

In 1902 there were made 4,496,533 tons of open-hearth steel by the basic process and 1,191,196 tons by the acid process; in 1903 the production by the basic process amounted to 4,734,913 tons and by the acid process to 1,094,998 tons. There was a decrease in the production of acid steel in 1903 as compared with 1902 of 96,198 tons, or a little over 8 per cent, but an increase in the production of basic steel of 238,380 tons, or 5.3 per cent.

In the following table the production by States of both acid and basic open-hearth steel ingots and castings in 1903 is given:

Production of basic and acid open-hearth steel in the United States in 1903, by States.

[Long tons.]

State.	Basic open-hearth steel.	Acid open-hearth steel.	Total.
New England	105,778	63,431	169,209
New York and New Jersey	71,537	33,061	104,598
Pennsylvania	3,557,493	885,237	4,442,730
Ohio	308,575	60,774	369,349
Illinois	390,513	32,406	422,919
Other States	301,017	20,089	321,106
Total	4,734,913	1,094,998	5,829,911

PRODUCTION OF OPEN-HEARTH STEEL CASTINGS.

The total production of open-hearth steel castings in 1903, included above, amounted to 400,348 long tons, of which 134,879 tons were made by the basic process and 265,469 tons were made by the acid process. In 1902 the production of open-hearth steel castings amounted to 367,879 tons, of which 112,404 tons were made by the basic process and 255,475 tons by the acid process.

The following table gives the production of open-hearth steel castings by the acid and basic processes in 1903, by States:

Production of open-hearth steel castings in the United States in 1903, by States.

[Long tons.]

State.	Basic castings.	Acid castings.	Total.
New England, New York, and New Jersey	5,311	30,783	36,094
Pennsylvania	14,483	167,538	182,021
Ohio, Illinois, and other States	115,085	67,148	182,233
Total	134,879	265,469	400,348

Massachusetts, Connecticut, Tennessee, Alabama, Indiana, Wisconsin, Missouri, and California made open-hearth steel castings in 1903 in addition to the States specifically mentioned in the table.

The growth of the open-hearth steel-casting industry in this country has been very rapid within the last six years, as is shown by the following table, the increase from 1898 to 1903 amounting to 279,761 long tons, or almost 232 per cent. The greatest growth has been in Pennsylvania, the increase in that State alone from 1898 to 1903 amounting to 134,751 long tons, or over 285 per cent. The production of open-hearth steel castings was first separately ascertained by the American Iron and Steel Association in 1898.

Production of open-hearth steel castings in the United States, 1898–1903, by States.

[Long tons.]

State.	1898.	1899.	1900.	1901.	1902.	1903.
New England, New York, and New Jersey	14,657	21,640	21,833	37,154	37,041	36,094
Pennsylvania	47,270	69,996	78,584	108,486	152,399	182,021
Ohio, Illinois, Indiana, and other States.	58,660	78,093	77,024	155,982	178,439	182,233
Total	120,587	169,729	177,491	301,622	367,879	400,348

PRODUCTION OF CRUCIBLE STEEL.

The production of crucible steel in the United States in 1903 amounted to 102,434 long tons, against 112,772 tons in 1902, 98,513 tons in 1901, 100,562 tons in 1900, 101,213 tons in 1899, 89,747 tons in 1898, 69,959 tons in 1897, 60,689 tons in 1896, 67,666 tons in 1895, 51,702 tons in 1894, and 63,613 tons in 1893. Ten States made crucible steel in 1903, namely, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Tennessee, Ohio, Indiana, Illinois, and Wisconsin. The direct castings produced in 1903, included above, amounted to 5,409 tons, against 4,955 tons in 1902 and 3,927 tons in 1901. Pennsylvania made a little less than three-fourths of the total crucible steel production in 1903, against a little over three-fourths in 1902, the year of maximum production in the whole country.

PRODUCTION OF MISCELLANEOUS STEEL.

The production of steel in the United States in 1903 by various minor processes amounted to 9,804 long tons, against 8,386 tons in 1902, 5,471 tons in 1901, 4,862 tons in 1900, 4,974 tons in 1899, 3,801 tons in 1898, 3,012 tons in 1897, 2,394 tons in 1896, 858 tons in 1895, 4,081 tons in 1894, and 2,806 tons in 1893. Blister, puddled, and "patented" steel, including "patented" steel castings, are included in these figures.

PRODUCTION OF ALL KINDS OF STEEL.

The production of all kinds of steel ingots and castings in 1903 amounted to 14,534,978 long tons, against 14,947,250 tons in 1902, a decrease of 412,272 tons, or 2.7 per cent. The maximum production of steel ingots and castings was reached in 1902; the year of next highest production was 1903. Blister, "patented," and all other kinds of steel are included in these figures.

In the following table the production in 1903 of all kinds of steel ingots and castings is given by States, in long tons. Of the total production, 430,265 tons were direct steel castings.

Production of all kinds of steel in the United States in 1903, by States.

[Long tons.]

State.	Bessemer.	Open-hearth.	Crucible and miscellaneous.	Total ingots and castings.
Massachusetts, Rhode Island, and Connecticut	....	169,209	2,385	171,594
New York and New Jersey	62,978	104,598	23,819	191,395
Pennsylvania	3,909,436	4,442,730	80,461	8,432,627
Delaware, Maryland, Virginia, West Virginia, District of Columbia, Kentucky, Tennessee, and Alabama	755,406	180,241	50	935,697
Ohio	2,330,134	369,349	10	2,699,493
Indiana and Illinois	1,366,569	497,398	3,314	1,867,281
Michigan, Wisconsin, Minnesota, Missouri, Colorado, Oregon, and California	168,306	66,386	2,199	236,891
Total	8,592,829	5,829,911	112,238	14,534,978

The total production of all kinds of steel ingots and castings in the United States in the fourteen years from 1890 to 1903 is given in detail in the following table:

Production of all kinds of steel ingots and castings in the United States, 1890–1903.

[Long tons.]

Year.	Bessemer.	Open-hearth.	Crucible.	Miscellaneous.	Total ingots and castings.
1890	3,688,871	513,232	71,175	3,793	4,277,071
1891	3,247,417	579,753	72,586	4,484	3,904,240
1892	4,168,435	669,889	84,709	4,548	4,927,581
1893	3,215,686	737,890	63,613	2,806	4,019,995
1894	3,571,313	784,936	51,702	4,081	4,412,032
1895	4,909,128	1,137,182	67,666	858	6,114,834
1896	3,919,906	1,298,700	60,689	2,394	5,281,689
1897	5,475,315	1,608,671	69,959	3,012	7,156,957
1898	6,609,017	2,230,292	89,747	3,801	8,932,857
1899	7,586,354	2,947,316	101,213	4,974	10,639,857
1900	6,684,770	3,398,135	100,562	4,862	10,188,329
1901	8,713,302	4,656,309	98,513	5,471	13,473,595
1902	9,138,363	5,687,729	112,772	8,386	14,947,250
1903	8,592,829	5,829,911	102,434	9,804	14,534,978

PRODUCTION OF ALL KINDS OF STEEL CASTINGS.

In 1903 the production of all kinds of steel castings amounted to 430,265 long tons, against 390,935 tons in 1902, 317,570 tons in 1901, 192,803 tons in 1900, 181,112 tons in 1899, and 131,937 tons in 1898. The increase in 1903 over 1902 was 39,330 tons, or over 10 per cent. The following table gives by States the production of all kinds of steel castings in 1903:

Production of all kinds of steel castings in the United States in 1903, by States.

[Long tons.]

State.	Bessemer.	Open-hearth.	Crucible and miscellaneous.	Total.
Massachusetts, Connecticut, New York, and New Jersey	6,337	36,094	5,827	48,258
Pennsylvania	1,626	182,021	2,068	185,715
District of Columbia, Virginia, Tennessee, Alabama, and Ohio	1,414	54,270	10	55,694
Indiana, Illinois, and Michigan	5,704	108,296	1,714	115,714
Wisconsin, Minnesota, Missouri, Colorado, Oregon, and California	3,018	19,667	2,199	24,884
Total	18,099	400,348	11,818	430,265

Of the total production of steel castings in 1903, Pennsylvania made over 43 per cent, against over 39 per cent in 1902; Illinois nearly 23 per cent, against over 25 per cent in 1902; and Ohio over 12 per cent, against over 8 per cent in 1902. No other State made 5 per cent in 1903 or 6 per cent in 1902.

PRODUCTION OF ALL KINDS OF RAILS.

The maximum production of Bessemer steel rails was reached in 1903, when 2,946,756 long tons were rolled, against 2,935,392 tons in 1902, an increase in 1903 of 11,364 tons. In the following table the production of Bessemer steel rails is given by States from 1898 to 1903. Rails rolled from purchased blooms, crop ends, "seconds," and rerolled, or renewed, rails are included. Renewed rails are rails that have been in use and are rolled down to smaller sections after reheating.

Production of all kinds of steel rails in the United States, 1898–1903, by States.

[Long tons.]

State.	1898.	1899.	1900.	1901.	1902.	1903.
Pennsylvania	1,053,326	1,224,807	1,195,255	1,406,008	1,148,425	1,186,284
Other States	923,376	1,045,778	1,188,399	1,464,808	1,786,967	1,760,472
Total	1,976,702	2,270,585	2,383,654	2,870,816	2,935,392	2,946,756

In addition to Pennsylvania the States which made Bessemer steel rails in 1903 were New York, New Jersey, Maryland, Ohio, Illinois, Wisconsin, Colorado, and Wyoming.

The production of Bessemer steel rails by the makers of Bessemer steel ingots, included above, amounted to 2,873,228 long tons in 1903, 2,876,293 tons in 1902, 2,836,273 tons in 1901, 2,361,921 tons in 1900, 2,240,767 tons in 1899, and 1,955,427 tons in 1898. In the following table is given the total production of all kinds of Bessemer steel rails from 1898 to 1903, the rails rolled by makers of Bessemer ingots being separated from those rolled by companies which did not operate Bessemer converters:

Production of all kinds of Bessemer steel rails in the United States, 1898–1903.

[Long tons.]

	1898.	1899.	1900.	1901.	1902.	1903.
By makers of Bessemer ingots	1,955,427	2,240,767	2,361,921	2,836,273	2,876,293	2,873,228
By all others	21,275	29,818	21,733	34,543	59,099	73,528
Total	1,976,702	2,270,585	2,383,654	2,870,816	2,935,392	2,946,756

As a rule the Bessemer rail mills were operated nearly to their full capacity in 1903, the demand for steel rails being good throughout the year. The new rail mill of the Lackawanna Steel Company, at Lackawanna, N. Y., was completed and put in operation late in 1903, and its first Bessemer steel rail was rolled on October 20 of that year. Twenty-two plants rolled or rerolled Bessemer steel rails in 1903, of which 6 were located in Pennsylvania, 3 in Maryland, 5 in Ohio, 2 in Illinois, 2 in New York, and 1 each in New Jersey, Wisconsin, Colorado, and Wyoming.

The total production of open-hearth steel rails in the United States in 1903 was 45,054 long tons, against 6,029 tons in 1902, 2,093 tons in 1901, and 1,333 tons in 1900. The maximum production of open-hearth rails was reached in 1903; the year of next highest production was 1881, when 22,515 tons were made. Alabama rolled almost all the open-hearth rails that were rolled in 1903, Pennsylvania being the only other producer. Over 37,000 tons of the open-hearth rails rolled weighed between 45 and 85 pounds per yard; a few tons weighed 85 pounds or over; the remainder weighed less than 45 pounds.

The production of iron rails in 1903 was 667 tons, all rolled in Tennessee, Alabama, Ohio, and California, and all weighing less than 45 pounds to the yard. In 1902 the production of iron rails was 6,512 tons, against 1,730 tons in 1901, 695 tons in 1900, 1,592 tons in 1899, and 3,319 tons in 1898.

The production of all kinds of rails in the United States in 1903 amounted to 2,992,477 long tons, against 2,947,933 tons in 1902, an increase of 44,544 tons. The year of maximum production was 1903; the year of next largest production was 1902.

In addition to our large production of rails we imported 95,555 tons of iron and steel rails in 1903. During the same year we exported 30,837 tons. In 1902 our exports of rails amounted to 67,666 tons and our imports to 63,522 tons. Virtually all our imports and exports of rails are steel rails.

WEIGHT OF ALL KINDS OF RAILS.

The following table gives the production of all kinds of rails in 1903, according to the weight of the rails per yard. Street rails are included in the total production of rails, but the quantity made in each year can no longer be given separately.

Production of all kinds of rails in the United States, 1897–1903, by kind of rails and by weight per yard.

[Long tons.]

Kind of rails.	Under 45 pounds.	45 pounds and less than 85.	85 pounds and over.	Total.
Bessemer steel rails	218,838	1,565,849	1,168,069	2,946,756
Open-hearth steel rails	7,257	37,789	58	45,054
Iron rails	667	....	....	667
Total for 1903	221,262	1,603,088	1,168,127	2,992,477
Total for 1902	261,887	2,040,884	645,162	2,947,933
Total for 1901	155,406	2,225,411	493,822	2,874,639
Total for 1900	157,531	1,626,093	602,058	2,385,682
Total for 1899	133,836	1,559,340	579,524	2,272,700
Total for 1898	123,881	1,404,150	453,210	1,981,241
Total for 1897	88,896	1,223,435	335,561	1,647,892

The increase in the production of rails weighing under 45 pounds to the yard, from 1897 to 1903, was 132,366 long tons; in rails weighing 45 and less than 85 pounds, 379,653 tons; and in rails weighing over 85 pounds, 832,566 tons. The increasing use in late years of rails weighing over 85 pounds to the yard, especially in 1903, is strikingly shown in the table.

PRODUCTION OF STRUCTURAL SHAPES.

Our statistics of iron and steel structural shapes embrace the production of beams, beam girders, zee bars, tees, channels, angles, and other structural forms, but they do not include plates or girders made from plates. Plates are provided for under other classifications, and in the general statistics of plates are included all plates cut to specifications.

Practically all the structural shapes and plates used for structural purposes are made of steel. The total production of strictly structural shapes in 1903 was 1,095,813 tons, and in 1902 it was 1,300,326 tons. The production of structural shapes in 1902 and 1903, by States, was as follows:

Production of iron and steel structural shapes in the United States, 1902–1903, by States.

[Long tons.]

State.	1902.	1903.	State.	1902.	1903.
Maine, New York, and New Jersey	52,554	32,884	Indiana, Illinois, Colorado, and California	18,762	24,363
Pennsylvania	1,178,760	1,004,375	Total	1,300,326	1,095,813
Delaware, Alabama, and Ohio	50,250	34,191			

Pennsylvania made over 91 per cent of the total production in 1903, against over 90 per cent in 1902; Ohio, 2.6 per cent, against over 3.7 per cent in 1902; and New Jersey over 3 per cent, against almost 3 per cent in 1902. No other State made 1.5 per cent of the total production in either year.

In the following table we give the production of structural shapes from 1892 to 1903. Prior to 1892 structural shapes were not separated from other rolled products in our statistics.

Production of iron and steel structural shapes in the United States, 1892–1903.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1892	453,957	1896	495,571	1900	815,161
1893	387,307	1897	583,790	1901	1,013,150
1894	505,901	1898	702,197	1902	1,300,326
1895	517,920	1899	850,376	1903	1,095,813

The increasing use of structural shapes in the construction of large office buildings, bridges, steel cars, etc., is shown in the table. Plates or girders made from plates are not included.

PRODUCTION OF WIRE RODS.

The production of iron and steel wire rods in the United States in 1903 amounted to 1,503,455 long tons, against 1,574,293 tons in 1902, 1,365,934 tons in 1901, and 846,291 tons in 1900, showing a decrease of 70,838 tons in 1903 as compared with 1902, or almost 4.5 per cent. Of the total production in 1903, 1,503,425 tons were steel rods and 30 tons were iron rods; in 1902 the quantity of steel rods rolled was 1,574,087 tons and iron rods 206 tons. The following table gives the production of wire rods, by States, in the last four years:

Production of wire rods in the United States, 1900–1903, by States.

[Long tons.]

State.	1900.	1901.	1902.	1903.
Massachusetts, Connecticut, Rhode Island, New York, and New Jersey	134,502	176,101	201,653	240,024
Pennsylvania	240,533	386,037	509,802	473,719
Kentucky, Alabama, and Ohio	244,731	422,679	440,458	424,172
Indiana, Illinois, and Colorado	226,525	381,117	422,380	365,540
Total	846,291	1,365,934	1,574,293	1,503,455

Pennsylvania made the largest quantity of wire rods in 1903, with Ohio second, Illinois third, and Massachusetts fourth. Eight other States—Kentucky, Indiana, Connecticut, New York, New Jersey, Rhode Island, Alabama, and Colorado—also rolled wire rods in 1903, in the order named. With the exception of Colorado, which first rolled wire rods in July, 1903, all the States named also rolled wire rods in 1902.

PRODUCTION OF WIRE NAILS.

The production of wire nails in the United States in 1903 amounted to 9,631,661 kegs of 100 pounds, as compared with 10,982,246 kegs in 1902, a decrease of 1,350,585 kegs, or over 12 per cent. The wire nails produced in 1903 were all made of steel, and were turned out by 57 works, as compared with 62 in 1902, 61 in 1901, 56 in 1900, and 59 in 1899. For 1903 it was necessary for the first time to estimate the production of two wire-nail plants.

The following table gives the production of wire nails by States in 1901, 1902, and 1903, in kegs of 100 pounds:

Production of wire nails in the United States, 1900–1903, by States.

[Kegs of 100 pounds.]

State.	1901.	1902.	1903.
New Hampshire, Massachusetts, Rhode Island, and Connecticut.	71,558	309,651	230,264
New York	136,118	132,854	190,524
Pennsylvania	3,118,508	4,219,604	3,918,272
Maryland, West Virginia, Kentucky, Alabama, and Ohio	3,638,894	3,251,918	2,589,310
Indiana and Illinois	2,716,748	2,902,006	2,367,820
Michigan, Wisconsin, Colorado, and California	127,001	166,213	335,471
Total	9,808,822	10,982,246	9,631,661

PRODUCTION OF CUT NAILS.

Our statistics of the production of iron and steel cut nails and cut spikes embrace only standard sizes of nails and spikes cut from plates. They do not embrace railroad and other spikes forged from bar iron, wire nails of any size, machine-made horseshoe nails, cut tacks, or hob, clout, basket, shoe, or other small sizes of nails.

The production of cut nails and of spikes cut from plates in 1903 was 1,435,893 kegs of 100 pounds each, against 1,633,762 kegs in 1902, a decrease of 197,869 kegs, or over 12 per cent. In 1886 the maximum production of 8,160,973 kegs was reached. In 1903 the production of wire nails exceeded that of cut nails by 8,195,768 kegs, in 1902 by 9,348,484 kegs, in 1901 by 8,261,582 kegs, in 1900 by 5,660,485 kegs, in 1899 by 5,713,790 kegs, in 1898 by 5,846,254 kegs, and in 1897 by 6,890,446 kegs.

Eleven States made cut nails in 1903, the same number as in 1902. The following table shows the production of iron and steel cut nails by States from 1898 to 1903, in kegs of 100 pounds. The wire nail production is added to the table. Except Indiana and Virginia all the States which produced cut nails in 1903 decreased their production as compared with 1902.

Production of cut nails in the United States, 1898–1903, by States.

[Kegs of 100 pounds.]

State.	1898.	1899.	1900.	1901.	1902.	1903.
Pennsylvania	768,171	920,183	777,611	833,469	752,729	725,000
Ohio	892,003	886,215	261,216	123,788	99,938	59,240
West Virginia and Indiana	184,942	178,006	168,469	150,222	271,362	274,808
Massachusetts and New Jersey	127,706	149,700	155,968	179,474	167,963	143,898
Illinois, Maryland, Virginia, and Kentucky	87,399	255,286	198,230	240,657	304,990	223,447
Missouri, Wisconsin, Colorado, Wyoming, and California	12,000	15,000	17,000	14,630	36,780	9,500
Total cut nails	1,572,221	1,904,340	1,573,494	1,542,240	1,633,762	1,435,893
Total wire nails	7,418,475	7,618,130	7,233,979	9,803,822	10,982,246	9,631,661
Grand total	8,990,696	9,522,470	8,807,473	11,346,062	12,616,008	11,067,554

PRODUCTION OF CUT AND WIRE NAILS SINCE 1886.

In the following table is given the production, in kegs of 100 pounds, of standard sizes of cut nails and spikes cut from plates from 1886, the year of maximum production, to 1903; also the production of standard sizes of wire nails for the same period. Prior to 1889, statistics of the production of wire nails were not collected by the American Iron and Steel Association. For the three preceding years, the statistics given are careful estimates.

Production of cut and wire nails in the United States, 1886–1903.

[Kegs of 100 pounds.]

Year.	Cut nails.	Wire nails.	Total.	Year.	Cut nails.	Wire nails.	Total.
1886	8,160,973	600,000	8,760,973	1895	2,129,894	5,841,403	7,971,297
1887	6,908,870	1,250,000	8,158,870	1896	1,615,870	4,719,860	6,335,730
1888	6,493,591	1,500,000	7,993,591	1897	2,106,799	8,997,245	11,104,044
1889	5,810,758	2,435,000	8,245,758	1898	1,572,221	7,418,475	8,990,696
1890	5,640,946	3,135,911	8,776,857	1899	1,904,340	7,618,130	9,522,470
1891	5,002,176	4,114,385	9,116,561	1900	1,573,494	7,233,979	8,807,473
1892	4,507,819	4,719,524	9,227,343	1901	1,542,240	9,803,822	11,346,062
1893	3,048,933	5,095,945	8,144,878	1902	1,633,762	10,982,246	12,616,008
1894	2,425,060	5,681,801	8,106,861	1903	1,435,893	9,631,661	11,067,554

PRODUCTION OF PLATES AND SHEETS.

The production of plate and sheet iron and steel in the United States in 1903, excluding nail plate, amounted to 2,599,665 long tons, against 2,665,409 tons in 1902, a decrease of 65,744 tons, or over 2.4 per cent. Skelp iron and steel are not included in our statistics of plates and sheets, but are classed with bars, hoops, etc., elsewhere. The following table gives the production, by States, of all kinds of plates and sheets in 1901, 1902, and 1903:

Production of plates and sheets in the United States, 1901-1903, by States.

[Long tons.]

State.	1901.	1902.	1903.
New England	416	4,394	8,580
New York and New Jersey	6,512	4,846	3,980
Pennsylvania	1,572,500	1,808,207	1,771,745
Delaware and Maryland	29,484	34,282	23,703
West Virginia	31,928	67,072	56,361
Kentucky and Alabama	47,503	56,828	40,635
Ohio	294,266	404,902	403,705
Indiana, Illinois, Michigan, Missouri, Wisconsin, Colorado, and California	271,816	284,888	290,956
Total	2,254,425	2,665,409	2,599,665

Fifteen States rolled plates and sheets in 1903, against 16 States in 1902. Of the total production of plates and sheets in 1903 Pennsylvania made over 68 per cent, against over 67 per cent in 1902; Ohio over 15.5 per cent, against over 15.1 per cent in 1902; and Illinois over 5.7 per cent, against almost 6 per cent in 1902. Indiana, West Virginia, Kentucky, Delaware, Missouri, Maryland, Alabama, Massachusetts, New Jersey, New York, Connecticut, and California also made plates and sheets in 1903 in the order named. Michigan and Wisconsin, which rolled plates and sheets in 1902, were not producers in 1903, and Connecticut, which was not a producer in 1902, reported a small quantity of plates and sheets in 1903.

The production of black plates or sheets for tinning in 1903, which is included above, amounted to 490,652 long tons, against 365,743 tons in 1902, an increase of 124,909 tons, or over 34 per cent. In 1901 the production of these plates and sheets amounted to 398,026 tons. Of the production in 1903, Pennsylvania made over 52 per cent, against over 48 per cent in 1902. Ohio, Indiana, West Virginia, Illinois, Maryland, and Missouri also made black plates for tinning in 1903 in the order named. In 1902, in addition to the States named, Michigan also made several thousand tons of black plates.

PRODUCTION OF TIN PLATES AND TERNE PLATES.

In the following table we give the production of tin plates and terne plates in the United States from July 1, 1891, to December 31, 1903, the production in 1902 and 1903 being partly estimated from the best available sources of information. The production of tin-dipping plants is included in all the figures that are given.

Production of tin plates and terne plates in the United States, 1891–1903.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1891 (last six months)	999	1896	160,362	1901	399,291
1892	18,803	1897	256,598	1902	360,000
1893	55,182	1898	326,915	1903	480,000
1894	74,260	1899	360,875		
1895	113,666	1900	302,665		

PRODUCTION OF ALL ROLLED IRON AND STEEL.

By the phrase rolled iron and steel we include all iron and steel rolled into finished forms. Forged armor plate, hammered axles, and other forgings are not included, nor such intermediate rolled forms as muck bars, billets, tin plate and sheet bars, etc.

The production of all iron and steel rolled into finished forms in the United States in 1903 was 13,207,697 long tons, against 13,944,116 tons in 1902, the year of maximum production, a decrease of 736,419 tons, or over 5.2 per cent. The increase in 1902 over 1901 amounted to 1,594,789 tons, or almost 13 per cent. Twenty-five States rolled either iron or steel or both iron and steel in 1903, against 26 States in 1902. The following table gives the total production by States of all kinds of finished rolled iron and steel in 1902 and 1903:

Production of rolled iron and steel in the United States in 1902 and 1903, by States.

[Long tons.]

State.	1902.	1903.	State.	1902.	1903.
Maine and Massachusetts	173,463	157,627	Alabama	131,298	112,245
Rhode Island and Connecticut	95,200	131,182	Ohio	2,019,952	1,883,643
New York	181,443	255,905	Indiana	415,049	405,076
New Jersey	139,310	145,282	Illinois	1,636,806	1,481,562
Pennsylvania	7,642,636	7,171,982	Michigan	89,297	77,593
Delaware	61,409	47,673	Wisconsin	232,752	204,685
Maryland	339,773	372,009	Missouri	64,741	75,470
Virginia	41,329	43,631	Colorado and Wyoming	200,771	169,409
West Virginia	247,812	252,331	Washington, Oregon, and California	35,357	38,904
Kentucky	170,320	158,280	Total	13,944,116	13,207,697
Tennessee and Georgia	25,398	23,208			

Pennsylvania made over 54 per cent of the total production of rolled iron and steel in 1903, against almost 55 per cent in 1902; Ohio over 14 per cent and Illinois over 11 per cent in each year; and Indiana over 3 per cent in 1903, against almost 3 per cent in 1902. No other State made over 2.9 per cent in 1903 or over 2.5 per cent in 1902. Maine, Minnesota, and Kansas, all three of which States have rolling mills, did not produce any rolled iron or steel in 1903, but Minnesota made a small quantity of direct steel castings in both 1902 and 1903. The single rolling mill in Maine, which was active for a short time in 1902, was destroyed by fire in August of that year. It was rebuilt in 1903, but not put in operation until October, 1904.

PRODUCTION OF IRON BLOOMS AND BILLETS.

In 1902 and 1903 there were no forges in operation in the United States for the manufacture of blooms and billets from the ore. In 1901 the blooms and billets so made amounted to 2,310 long tons, against 4,292 tons in 1900, 3,142 tons in 1899, 1,767 tons in 1898, 1,455 tons in 1897, 1,346 tons in 1896, 40 tons in 1895, 40 tons in 1894, 864 tons in 1893, and 2,182 tons in 1892. All the ore blooms produced since 1897 were made by the Chateaugay Ore and Iron Company, of Plattsburg, N. Y., at its Standish Works, which were, however, idle in 1902 and 1903.

The iron blooms produced in forges from pig iron and scrap in 1903, and which were for sale and not for the consumption of the makers, amounted to 9,939 tons, against 12,002 tons in 1902, 8,237 tons in 1901, 8,655 tons in 1900, 9,932 tons in 1899, 6,345 tons in 1898, 7,159 tons in 1897, 6,494 tons in 1896, 7,185 tons in 1895, 3,221 tons in 1894, and 6,605 tons in 1893. All the pig and scrap blooms made in forges from 1895 to 1903, and for sale, were made in New York, Pennsylvania, and Maryland.

PRODUCTION OF ROLLED IRON AND STEEL SINCE 1887.

The total production of all kinds of iron and steel rolled into finished forms in the United States from 1887 to 1903 is given as follows:

Production of rolled iron and steel in the United States, 1887–1903.

[Long tons.]

Year.	Iron and steel rails.	Plates and sheets, except nail plate.	Wire rods.	Cut nails.	Bars, hoops, shapes, and all other.	Total.
1887	2,139,640	603,355	....	308,432	2,184,279	5,235,706
1888	1,403,700	609,827	279,769	289,891	2,034,162	4,617,349
1889	1,522,204	716,496	363,851	259,409	2,374,968	5,236,928
1890	1,885,307	809,981	457,099	251,828	2,618,660	6,022,875
1891	1,307,176	678,927	536,607	223,312	2,644,941	5,390,963
1892	1,551,844	751,460	627,829	201,242	3,033,439	6,165,814
1893	1,136,458	674,345	537,272	136,113	2,491,497	4,975,685
1894	1,021,772	682,900	673,402	108,262	2,155,875	4,642,211
1895	1,306,135	991,459	791,130	95,085	3,005,765	6,189,574
1896	1,122,010	965,776	623,986	72,137	2,731,932	5,515,841
1897	1,647,892	1,207,286	970,736	94,054	3,081,760	7,001,728
1898	1,981,241	1,448,301	1,071,683	70,188	3,941,957	8,513,370
1899	2,272,700	1,903,505	1,036,398	85,015	4,996,801	10,294,419
1900	2,385,682	1,794,528	846,291	70,245	4,390,697	9,487,443
1901	2,874,639	2,254,425	1,365,934	68,850	5,785,479	12,349,327
1902	2,947,933	2,665,409	1,574,293	72,936	6,683,545	13,944,116
1903	2,992,477	2,599,665	1,503,455	64,102	6,047,998	13,207,697

SUMMARY OF IRON AND STEEL STATISTICS FOR 1902 AND 1903.

Summary of iron, steel, etc., statistics for the United States for 1902 and 1903.

[Long tons, except as stated.]

Item.	1902.	1903.
Production of iron ores	35,554,135	35,019,308
Imports of iron ores	1,165,470	980,440
Production of bituminous coal	232,336,468	252,454,775
Production of Pennsylvania anthracite	36,940,710	66,613,454
Production of all kinds of coal	269,277,178	319,068,229
Shipments of Pennsylvania anthracite	31,200,890	59,362,831
Imports of coal	2,551,381	3,446,402
Exports of coal	6,126,946	8,312,098
Production of coke ... short tons	25,401,730	25,262,360
Production of pig iron	17,821,307	18,009,252
Production of spiegeleisen and ferromanganese, included in pig iron	212,981	192,661
Production of Bessemer steel	9,138,363	8,592,829
Production of open-hearth steel	5,687,729	5,829,911
Production of crucible steel	112,772	102,434
Production of blister and patented steel	8,386	9,804
Production of all kinds of steel	14,947,250	14,534,978
Production of open-hearth steel castings	367,879	400,348
Production of all kinds of steel castings	390,935	430,26
Production of Bessemer steel rails	2,935,392	2,946,75
Production of open-hearth steel rails	6,029	45,05
Production of iron rails	6,512	66
Production of all kinds of rails	2,947,933	2,992,47
Production of structural shapes	1,300,326	1,095,81
Production of iron and steel wire rods	1,574,293	1,503,45
Production of plate and sheet iron and steel, except nail plate	2,665,409	2,599,66
Production of iron and steel cut nails and cut spikes, kegs of 100 pounds	1,633,762	1,435,89
Production of iron and steel wire nails ... kegs of 100 pounds	10,982,246	9,631,66
Production of bar, bolt, hoop, skelp, rolled axles, rolled armor plate, etc	5,383,219	4,952,1
Production of all rolled iron and steel, including cut nails and excluding rails	10,996,183	10,215,2
Production of all rolled iron and steel, including both cut nails and rails.	13,944,116	13,207,6
Production of tin plates and terne plates	360,000	480,0
Production of ore, pig, and scrap blooms for sale	12,002	9,9
Value of imports of iron and steel	$41,468,826	$41,255,8
Value of exports of iron and steel	$97,892,036	$99,035,8
New railroad built (revised figures) ... miles	5,063	4,7
Immigrants in the year ended Dec. 31	739,289	937,3

STATISTICS OF STEEL SHIPBUILDING.

In the fiscal year ending June 30, 1903, there were built in the United States 108 steel vessels, and in the fiscal year 1904 there were built 98 steel vessels. The gross tonnage of the vessels built in the fiscal year 1903 was 258,219 tons, and the gross tonnage of the vessels built in the fiscal year 1904 was 241,080 tons. In the fiscal year 1902 one iron vessel, of 193 tons' capacity, was built at Wilmington, Del. This may prove to have been the last iron vessel to be built in the United States. Vessels for the United States Navy are not included in the figures given below, which have been furnished by the Hon. Eugene T. Chamberlain, Commissioner of Navigation. The following table, received from the Commissioner, shows the number and gross tonnage of the steel vessels launched and officially numbered during the fiscal year ending June 30, 1903:

Number and tonnage of steel vessels launched and officially numbered in the United States in the fiscal year 1903, by ports.

Port.	Sailing.		Steam.		Barges.		Total.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Bath, Me	3	6,966					3	6,966
Boston, Mass	1	5,218					1	5,218
Bridgeport, Conn			1	47			1	47
New York, N. Y			7	3,522			7	3,522
Newark, N. J			1	361	1	299	2	660
Philadelphia, Pa			27	70,983			27	70,983
Wilmington, Del			4	5,404	1	1,423	5	6,827
Baltimore, Md			3	8,955			3	8,955
Richmond, Va			1	223			1	223
Newport News, Va			3	17,594			3	17,594
Jacksonville, Fla			1	194			1	194
Memphis, Tenn			1	8			1	8
Louisville, Ky			1	240			1	240
St. Louis, Mo			1	88			1	88
Dubuque, Iowa			3	2,588			3	2,588
Buffalo, N. Y			4	3,384	1	3,351	5	6,735
Cleveland, Ohio			12	45,682			12	45,682
Toledo, Ohio			4	11,542			4	11,542
Detroit, Mich			4	10,800			4	10,800
Port Huron, Mich			6	21,845	1	855	7	22,700
Marquette, Mich			3	11,079			3	11,079
Grand Haven, Mich			2	116			2	116
Chicago, Ill			5	14,760			5	14,760
San Francisco, Cal			4	10,428			4	10,428
Port Townsend, Wash			2	264			2	264
Total	4	12,184	100	240,107	4	5,928	108	258,219

Of the 108 vessels built in the fiscal year 1903, 42 were built at ports on the Great Lakes, their tonnage amounting to 123,414 long tons out of a total tonnage of 258,219 tons.

The following table, also received from Commissioner Chamberlain, gives the number and gross tonnage of the steel vessels launched and officially numbered during the fiscal year 1904:

Number and tonnage of steel vessels launched and officially numbered in the United States in the fiscal year 1904, by ports.

Port.	Sailing.		Steam.		Barges.		Total.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Boston, Mass	1	3,708					1	3,708
New York, N. Y	3	11,582	4	2,593	1	494	8	14,669
Newark, N. J			1	1,225			1	1,225
Philadelphia, Pa			19	46,315	2	458	21	46,773
Wilmington, Del			4	6,680	1	1,423	5	8,103
Baltimore, Md			5	9,156			5	9,156
Richmond, Va			2	446			2	446
New Orleans, La			2	58			2	58
Pittsburg, Pa					1	479	1	479
Burlington, Vt			1	1,195			1	1,195
Buffalo, N. Y			4	1,979	1	629	5	2,608
Cleveland, Ohio			14	66,337			14	66,337
Toledo, Ohio			4	8,133			4	8,133
Detroit, Mich			7	23,593			7	23,593
Port Huron, Mich			6	17,980			6	17,980
Marquette, Mich			4	16,723			4	16,723
Chicago, Ill			7	18,028			7	18,028
San Francisco, Cal			4	1,866			4	1,866
Total	4	15,290	88	222,307	6	3,483	98	241,080

Of the 98 vessels built in the fiscal year 1904, 47 were built at ports on the Great Lakes, their tonnage amounting to 153,402 long tons out of a total tonnage of 241,080 tons.

IRON AND STEEL WORKS OF THE UNITED STATES.

The American Iron and Steel Association has recently issued a new edition of its directory to the iron and steel works of the United States, and from this publication the following information is obtained which shows the growth of the country's iron and steel industries from November, 1901, to June, 1904—particularly the increase or decrease in the number of plants and in their productive capacity.

Whole number of blast furnaces.—In the edition of the directory for 1901 there were described 406 completed furnaces as being then active or as having been reported as likely to be some day active. The annual capacity of these furnaces as reported by their owners amounted, in round numbers, to 24,800,000 long tons, not all of which capacity could, of course, be employed at the same time, nor would some of the furnaces enumerated ever run again. In the edition for 1904 there are described 428 completed furnaces, either active or reported as likely to be some day active. Eliminating some of the furnaces in the latter category as being probably dead for all time there remain about 410 live furnaces to-day. The annual capacity of these furnaces is placed, in round numbers, at 27,675,000 long tons. The actual production of pig iron in 1903 was 18,009,252 long tons.

Furnaces building.—When the directory for 1901 appeared 12 furnaces were being built, namely, 2 in New York, 1 in New Jersey, 3 in Pennsylvania, 1 in West Virginia, 2 in Alabama, 1 in Michigan, and 2 in Colorado. In the edition for 1904 there are enumerated 17 furnaces in course of erection or as being rebuilt, namely, 3 in New York, 5 in Pennsylvania, 1 in Virginia, 2 in Alabama, 4 in Ohio, 1 in Michigan, and 1 in Colorado. In the figures for both years projected furnaces or furnaces that had been undertaken and work upon which had been suspended are not included.

Fuel used in blast furnaces.—The 406 furnaces described in the directory for 1901 were classified as follows: Fifty-five used charcoal as fuel, 5 used mixed charcoal and coke, and 346 used anthracite and bituminous fuel. Of the 428 furnaces that are described in the directory for 1904, 56 use charcoal and 372 use anthracite and bituminous fuel. No furnaces now use mixed charcoal and coke. Five furnaces, not included above, make ferrosilicon, ferrochrome, ferro-tungsten, etc., by electricity.

Capacity of furnaces according to fuel used.—The average annual capacity of the 55 charcoal and 5 mixed charcoal and coke furnaces in 1901 was 14,179 long tons, and the average annual capacity of the 56 charcoal furnaces that are described in 1904 is 15,207 tons. The average annual capacity of the mineral fuel furnaces in 1901 was 69,252 tons; in June, 1904, it is 73,286 tons.

Rolling mills and steel works.—In the edition of the directory for 1901 there were enumerated 527 completed rolling mills and steel works, 28 in course of erection, 1 being rebuilt, 1 to be rebuilt, and 6 projected. In the edition for 1904 there are enumerated 572 completed rolling mills and steel works, 12 in course of erection, 1 being rebuilt, and 2 partly erected. In addition the directory for 1904 mentions 14 projected plants. The annual capacity of the completed rolling mills in 1904 amounts to 25,978,050 tons of finished rolled products, as compared with 23,220,350 tons in 1901.

Puddling furnaces.—The number of puddling furnaces in November, 1901, each double furnace counting as 2 single furnaces, was 3,251. In June, 1904, there were 3,161 puddling furnaces. The highest number of puddling furnaces reported in any edition of the directory was in 1884, when 5,265 were enumerated.

Bessemer steel works.—The total number of completed Bessemer steel works in November, 1901, including 1 Clapp-Griffiths plant, 2 Robert-Bessemer plants, and 9 Tropenas and "special" Bessemer plants, was 47, and the whole number of converters was 100. In June, 1904, there were 32 standard Bessemer steel works with 75 converters, 1 Clapp-Griffiths plant with 1 converter, 2 Robert-Bessemer plants with 3 converters, 10 Tropenas plants with 14 converters, 1 Bookwalter plant with 1 converter, 1 Evans-Wills plant with 2 converters, and 4 plants with 7 converters which make steel by special processes; total number of Bessemer plants, 51; total number of converters, 103. The increase in the number of small Bessemer plants in the last few years is noteworthy. Since November, 1901, 6 standard Bessemer plants, with 15 converters, have been dismantled. In addition, 2 Tropenas plants with 3 converters have been abandoned. The annual capacity of the completed and building Bessemer converters in November, 1901, was 12,998,700 long tons; in June, 1904, it was 13,628,600 tons, an increase of 629,900 tons. No basic-Bessemer steel is made in this country.

Open-hearth steel works.—The directory for 1901 described 112 completed open-hearth steel plants, with 403 completed furnaces. In the directory for 1904 there are described 135 completed plants, with 549 completed furnaces, and 28 building and partly erected furnaces. The annual capacity of the 549 completed and of the 28 building and partly erected open-hearth furnaces, in ingots and direct castings, in June, 1904, was 11,335,100 long tons, against an annual capacity in November, 1901, of 8,289,750 tons, showing an increase of 3,045,350 tons.

Growth of basic steel.—In the directory for 1904 the character of the product made at the open-hearth steel works, whether acid or basic steel, or both, is indicated. Of the 403 completed furnaces in November, 1901, 236 were prepared to make basic steel and 167 to make acid steel, and of the 46 building furnaces 33 would make basic steel and 13 acid steel. The completed and building basic furnaces had an annual capacity of 6,415,100 tons, and the acid furnaces of 1,874,650 tons. In the directory for 1904, 185 open-hearth furnaces are described as making acid steel and 364 as making basic steel; also 4 acid and 24 basic furnaces as being built or as partly erected: Total, 189 acid and 388 basic furnaces. The acid furnaces have an annual capacity of 2,015,900 long tons of ingots and castings, and the basic furnaces of 9,319,200 tons.

Crucible steel works.—In November, 1901, there were 45 completed crucible steel plants, equipped with 2,896 pots, and their aggregate capacity was 175,000 tons. In June, 1904, there were 57 completed plants, the number of pots was 3,606, and the aggregate annual capacity of the plants was 226,610 tons.

Steel castings.—In 1901 there were 56 open-hearth steel plants which were prepared to make steel castings, and in June, 1904, there were 84 plants. The production of open-hearth steel castings has greatly increased since 1898. As already mentioned, the number of small

Bessemer plants has also increased since 1901, all of which make steel castings. Steel castings are also made by 26 crucible plants, also by a few plants which use special processes.

Rail mills.—In the edition of the directory for 1901 there were enumerated 45 rolling mills which were prepared to make standard, girder, light T, and other iron and steel rails, and 3 mills as in course of erection. In the edition for 1904 there are enumerated 44 completed rail mills, 1 building, and 1 projected.

Structural mills.—The whole number of works which are now equipped to roll beams, beam girders, zee bars, tees, channels, angles, bridge rods, building rods, plates for bridge work, structural tubing, etc., is 70, as compared with 67 in November, 1901.

Plate and sheet mills.—In the directory for 1901 there were enumerated 153 completed plate and sheet mills, 7 building, and 1 projected. In the directory for 1904 there are enumerated 157 completed mills, 2 building, 1 partly erected, and 4 projected.

Iron and steel skelp mills.—In the directory for 1901 there were enumerated 60 completed iron and steel skelp mills and 2 building. In the directory for 1904 there are enumerated 61 completed mills and 2 projected.

Black-plate mills.—In the directory for 1901 there were enumerated 46 completed black plate plants, 6 building, and 1 projected. In the directory for 1904 there are mentioned 49 completed and 3 building plants.

Tin-plate and terne-plate works.—In November, 1901, there were 55 completed tin-plate and terne-plate works, 7 building, and 1 projected. In the directory for 1904 there are enumerated 53 completed works, 2 building, and 1 projected.

Wire rods.—In November, 1901, there were 32 completed wire-rod mills, 4 building, 1 rebuilding, and 1 projected. In June, 1904, there were 33 mills equipped to roll iron and steel wire rods.

Cut-nail works.—In November, 1901, there were 32 rolling mills which were devoted in whole or in part to the manufacture of cut nails and cut spikes, containing 3,161 nail and spike machines. In June, 1904, there were 23 rolling mills which made cut nails and cut spikes, equipped with 2,302 nail and spike machines.

Wire-nail works.—A full description of the wire-nail works of the United States will be found in the supplement to the directory for 1901, published in 1903, in which 69 wire-nail works are described.

Natural gas.—In the directory for 1901 there were enumerated 110 completed iron and steel works which used natural gas and 7 were in course of erection. In June, 1904, the total number of works which used natural gas was 135, and in addition 2 works to use natural gas were being erected, 1 was partly erected, 1 was rebuilding, and 2 were projected.

Forges and bloomeries.—The number of pig and scrap iron bloomeries which made blooms, billets, etc., for sale in November, 1901, was 8, nearly all of which were active in that year. The number of forges which made blooms directly from the ore was 2. The number of bloomeries enumerated in 1904 is 8 completed and 1 building. The number of forges which make blooms directly from the ore is reduced to 1, located in New York.

STATISTICS OF THE CANADIAN IRON TRADE FOR 1903.

PRODUCTION OF PIG IRON IN CANADA.

The American Iron and Steel Association has received from the manufacturers the statistics of the production of all kinds of pig iron in Canada in the calendar year 1903. They show a decrease of 54,139 long tons, or nearly 17 per cent, as compared with 1902, but an increase of 20,442 tons as compared with 1901.

The total production in 1903 amounted to 265,418 long tons, against 319,557 tons in 1902, 244,976 tons in 1901, and 86,090 tons in 1900. In the first half of 1903 the production was 132,930 tons and in the second half it was 132,488 tons, a decrease of 442 tons. Of the total production in 1903 exactly 247,905 tons were made with coke and 17,513 tons with charcoal. Nearly one-half of the total production, 126,892 tons, was basic pig iron. Less than 1,000 tons of Bessemer pig iron were made. Spiegeleisen and ferromanganese have not been made since 1899.

The following table gives the total production of all kinds of pig iron (including spiegeleisen and ferromanganese) in Canada from 1894 to 1903. Prior to 1894 the statistics of pig-iron production in Canada were not collected by the American Iron and Steel Association.

Production of pig iron in Canada, 1894–1903.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1894	44,791	1898	68,755	1902	319,557
1895	37,829	1899	94,077	1903	265,418
1896	60,030	1900	86,090		
1897	53,796	1901	244,976		

On December 31, 1903, the unsold stocks of pig iron in Canada amounted to 19,168 long tons, as compared with about 20,000 tons at the close of 1902, 59,472 tons at the close of 1901, and 12,465 tons at the close of 1900.

On December 31, 1903, Canada had 15 completed blast furnaces, of which 9 were in blast and 6 were idle. Of this total 11 were equipped to use coke for fuel and 4 to use charcoal. In addition 3 coke furnaces and 1 charcoal furnace were being built or were partly erected on December 31, but work on at least two of the furnaces had been suspended for some time.

The statistics of the production of pig iron in Canada in the first six months of 1904 have also been received from the manufacturers. The figures show a decrease as compared with either of the two halves of 1903, as will be seen by the following table, which gives the production by fuels, in long tons, in half-yearly periods:

Production of pig iron in Canada in 1903 and 1904, by half-years, and by kind of fuel used.

Fuel used.	First half of 1903.	Second half of 1903.	First half of 1904.
	Long tons.	*Long tons.*	*Long tons.*
Coke	123,500	124,405	111,840
Charcoal	9,430	8,083	8,803
Total	132,930	132,488	120,643

The decrease in production in the first half of 1904, as compared with the first half of 1903, was 12,287 tons, and as compared with the second half of 1903 it was 11,845 tons. Of the production in the first half of 1904 35,291 tons were basic pig iron, against 69,325 tons in the first half of 1903 and 57,567 tons in the second half of that year. A small quantity of Bessemer pig iron was produced in the second half of 1903, but no Bessemer pig iron was made in the first half of 1903 or in the first half of 1904.

The unsold pig iron held by manufacturers on June 30, 1904, amounted to 36,868 long tons, as compared with 19,168 tons on December 31, 1903, and 13,585 tons on June 30, 1903. Of the unsold stocks on June 30, 1904, a little less than 4,000 tons were made with charcoal, the remainder being coke iron.

During the first half of 1904 the total number of furnaces in Canada actually in blast for the whole or a part of the period was 10, of which 7 used coke and 3 used charcoal. The number of furnaces idle during the whole period was 5, of which 4 used coke when last in blast and 1 used charcoal. Of the 15 completed blast furnaces in Canada on June 30, 1904, 7 were located in Nova Scotia, 3 in Quebec, and 5 in Ontario.

PRODUCTION OF STEEL IN CANADA.

The American Iron and Steel Association has also received from the manufacturers the statistics of the production of steel ingots and castings and of rolled iron and steel in Canada in 1903.

The total production of steel ingots and castings in Canada in 1903 was 181,514 long tons, against 182,037 tons in 1902, a decrease of 523 tons. Bessemer and open-hearth steel ingots and castings were made in each year. Almost all the open-hearth steel reported in 1902 and 1903 was made by the basic process. The direct steel castings made in 1903 amounted to 4,506 tons.

The following table gives the production of all kinds of steel ingots and castings in Canada from 1894 to 1903, inclusive:

Production of all kinds of steel ingots and castings in Canada, 1894–1903.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1894	25,685	1898	21,540	1902	182,037
1895	17,000	1899	22,000	1903	181,514
1896	16,000	1900	23,577		
1897	18,400	1901	26,084		

PRODUCTION OF ROLLED IRON AND STEEL IN CANADA.

The production of Bessemer and open-hearth steel rails in 1903 amounted to 1,243 long tons, against 33,950 tons in 1902; structural shapes, 1,983 tons, against 423 tons in 1902; cut nails made by rolling mills and steel works having cut-nail factories connected with their plants, 118,686 kegs of 100 pounds, against 114,685 kegs in 1902; plates and sheets, 2,450 tons, against 2,191 tons in 1902; all other finished rolled products, excluding muck and scrap bars, blooms, billets, sheet bars, and other unfinished forms, 118,541 tons, against 119,801 tons in 1902. The total quantity of all kinds of iron and steel rolled into finished forms in Canada in 1903 amounted to 129,516 long tons, against 161,485 tons in 1902.

The following table gives the production of all kinds of iron and steel rolled into finished forms in Canada from 1895 to 1903, inclusive:

Production of all kinds of rolled iron and steel in Canada, 1895–1903.

[Long tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1895	66,402	1898	90,303	1901	112,007
1896	75,043	1899	110,642	1902	161,485
1897	77,021	1900	100,690	1903	129,516

On December 31, 1903, there were 18 completed rolling mills and steel works in Canada, 1 building steel plant, and 1 projected rolling mill. Of the completed plants, 2 were equipped for the manufacture of steel castings only, 5 for the manufacture of Bessemer or open-hearth steel ingots and rolled products, and 11 for the manufacture of rolled products only. The building plant is being equipped for the manufacture of basic open-hearth ingots only. The projected plant is to be equipped for the manufacture of skelp and bar iron, the former for use in a wrought-iron pipe plant which was put in operation on May 4, 1903.

Of the 18 completed rolling mills and steel works in Canada on December 31, 1903, 3 were located in Nova Scotia, 5 in Quebec, 9 in Ontario, and 1 in New Brunswick. The building plant is in Nova Scotia, and the projected plant is in Ontario.

CHANGES IN CANADIAN IRON AND STEEL WORKS.

The Nova Scotia Steel and Coal Company (Limited), of New Glasgow, Nova Scotia, has completed a new coke blast furnace at Sydney Mines, Nova Scotia. The furnace was first blown in on August 30, 1904. It is 85 by 17 feet, is equipped with 4 Roberts stoves, and has an annual capacity of about 75,000 long tons of forge and basic pig iron. The furnace is also equipped with one pig-iron casting machine. The company is also erecting a new open-hearth steel plant at Sydney Mines, which is to be equipped with four 40-long-ton basic furnaces, of which three are to be stationary Wellman furnaces and one is to be a tilting furnace. Ingots only will be made, for which the plant will have an annual capacity of about 60,000 long tons.

The Halifax Rolling Mills, near Halifax, Nova Scotia, have been dismantled. They were built in 1878, and were equipped with two heating furnaces, two trains of rolls, and twenty cut-nail machines. They were formerly operated by the Halifax Rolling Mills Company, but had been idle for years.

The Montreal Steel Works, of Montreal, Canada, are now equipped with two 15-long-ton acid open-hearth-steel furnaces, a second furnace having been added in 1903. The 3,000-pound modified Bessemer converter with which the plant is also equipped was not operated in 1903. The works produce steel castings.

The Peck Rolling Mills (Limited) have succeeded Peck, Benny & Co., of Montreal. The rolling mill of the company was partly destroyed by fire in 1903, but was rebuilt in the same year.

The Iron and Steel Company of Canada (Limited) has acquired the rolling mill at Belleville, Ontario, formerly operated by the Abbott-Mitchell Iron and Steel Company of Ontario (Limited). M. Wright is president, D. Jackson is vice-president, and J. F. Wills is managing director, secretary, and treasurer.

The Toronto Bolt and Forging Company (Limited) is now the owner of the rolling mill at Sunnyside, Toronto, formerly operated by the

McDonell Rolling Mills Company of Toronto (Limited). George Gillies is president of the new organization, T. H. Watson is secretary and treasurer, John Stephens is general superintendent, and C. O. Jolley is assistant superintendent.

The Page-Hersey Iron and Tube Company (Limited), of Guelph, Ontario, which manufactures wrought-iron pipe, did not install in 1903 the 2 trains of rolls for the manufacture of skelp and bar iron which it proposed adding to its works. The company is now uncertain when the rolls will be added.

THE WORLD'S IRON TRADE IN 1903.

THE WORLD'S PRODUCTION OF IRON ORE AND COAL.

The following table gives the production of iron ore and coal in all countries in 1903, except in some instances, when figures for 1902 are given. Tons of 2,240 pounds are used in giving the production of the United States, Great Britain, Canada, Cuba, India, Natal, South African Republic, New South Wales, New Zealand, other Australasia, and "other countries," and metric tons of 2,204 pounds are used for all other countries, the latter being used as the equivalent of long tons in ascertaining the total production of all countries. The statistics are from official sources. The Belgian coal statistics do not include lignite.

World's production of iron ore and coal and lignite in 1903, by countries.

Country.	Iron ore.			Coal and lignite.		
	Year.	Quantity.	Percentage.	Year.	Quantity.	Percentage.
		Tons.			*Tons.*	
United States	1903	35,019,308	34.71	1903	319,068,229	36.65
Great Britain	1903	13,715,645	13.59	1903	230,334,469	26.46
Germany and Luxemburg	1903	21,230,639	21.04	1903	162,312,075	18.65
France	1902	5,003,782	4.96	1903	35,002,992	4.02
Belgium	1902	166,480	.16	1903	[b]23,870,820	2.74
Austria-Hungary [a]	1902	3,329,128	3.30	1902	39,904,318	4.58
Russia and Finland	1902	5,648,227	5.60	1902	15,508,924	1.78
Sweden	1903	3,677,841	3.65	1903	320,390	.04
Spain	1903	8,478,600	8.40	1903	2,798,113	.32
Italy	1902	240,705	.24	1902	413,810	.05
Canada	1902	360,717	.36	1903	7,139,852	.82
Cuba	1903	624,858	.62	......	....	....
South African Republic	......	....	....	1903	2,258,284	.26
Natal	......	....	....	1903	713,548	.08
India	1902	85,235	.08	1903	7,480,589	.86
Greece	1902	546,409	.54	1902	8,546	.00
New South Wales	1902	13,555	.01	1903	6,354,846	.73
New Zealand	......	....	....	1902	1,362,702	.16
Other Australasia	1902	116,994	.12	1902	916,442	.11
Japan	1901	70,172	.07	1901	8,945,938	1.08
Algeria	1902	525,012	.52	1902	285	.00
Other countries (estimated)	1903	2,046,698	2.03	1903	5,782,833	.66
Total	......	100,900,000	100.00	......	870,498,000	100.00

[a] Includes Bosnia and Herzegovina. [b] Lignite not included.

The iron ore figures for "other countries" include 728,721 long tons which were mined by Newfoundland in 1902.

THE WORLD'S PRODUCTION OF PIG IRON AND STEEL.

In the following table is given the production of pig iron and steel in all countries in 1903, except in a few cases in which figures for 1902 are given. Long tons of 2,240 pounds are used for the United States, Great Britain, Canada, and "Other countries," and metric tons of 2,204 pounds for all other countries, metric tons being used as the equivalent of long tons in ascertaining the total production for all countries. The statistics of steel production for the United States, Great Britain, Germany and Luxemburg, France, Belgium, Austria-Hungary, Russia and Finland, Sweden, Spain, and Canada embrace ingots and in some cases direct castings, but for Italy complete ingot statistics are not available and the statistics for finished steel have been used.

World's production of pig iron and steel in 1903, by countries.

Country.	Pig iron.			Steel.		
	Year.	Quantity.	Percentage.	Year.	Quantity.	Percentage.
		Tons.			Tons.	
United States	1903	18,009,252	38.80	1903	14,534,978	40.93
Great Britain	1903	8,811,204	18.98	1903	a 5,134,101	14.46
Germany and Luxemburg	1903	10,085,634	21.73	1903	8,801,515	24.79
France	1903	2,827,668	6.09	1903	1,905,000	5.36
Belgium	1903	1,216,500	2.62	1903	981,740	2.76
Austria-Hungary b	1902	1,470,000	3.17	1902	1,190,000	3.35
Russia and Finland	1902	2,592,9[illegible]2	5.59	1902	2,118,971	5.97
Sweden	1903	506,825	1.09	1903	318,897	.90
Spain	1903	380 [illegible]84	.82	1903	199,642	.56
Italy	1902	c 43,335	.09	1902	108,864	.31
Canada	1903	265,418	.57	1903	181,514	.51
Other countries (estimated)	1903	210,898	.45	1903	34,778	.10
Total	......	46,420,000	100.00	......	35,510,000	100.00

a Does not include direct steel castings. b Includes Bosnia and Herzegovina. c Includes blast-furnace castings.

In tables that have previously appeared, the world's probable total production of pig iron has been given as 825,000 long tons in 1800; as 1,825,000 tons in 1830; as 4,750,000 tons in 1850; as 11,900,000 tons in 1870; as 17,950,000 tons in 1880; as 27,157,000 tons in 1890; as 40,400,000 tons in 1900, and now it is estimated as 46,420,000 tons in 1903.

In 1879 the world's production of steel was estimated as amounting to 3,021,000 long tons. The production of 1889 was estimated as amounting to 10,948,000 tons. The figures given in the preceding table show that the production had increased to 35,510,000 tons in 1903.

PRODUCTION OF MANGANESE ORES IN 1903.

By John Birkinbine.

PRODUCTION.

In the year ending December 31, 1903, the production of manganese ore in the United States was 2,825 long tons, valued at $25,335, or $8.97 per ton. This is an apparent but not an actual decline from the quantity reported in 1902 (16,477 tons) of 13,652 long tons, or 83 per cent. In the total for the year 1902 was included a report, obtained through the United States census local agent, of 9,000 tons from the State of Montana, none of the ore being shipped (to which fact attention was called in the report). This operation being omitted, the corrected total for 1902 is but 7,477 long tons. Subsequent investigation has shown that the ore reported was not actually mined, and it therefore has not been included in the 1903 report, although exploratory work has been prosecuted and a liberal amount of ore exposed. The geographical location of these reported deposits is not such as to encourage the expectation of immediate development and shipment upon a liberal scale.

The following table shows the production of manganese ores in the United States in the years 1896 to 1903 by States, together with the total valuations and the average value per ton:

Production and value of manganese ores in the United States, 1896–1903.

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, 1896-1903—Continued.

State.	1899.			1900.			1901.		
	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	....	......	....	....	......	....	17	$111	$6.50
Arkansas	356	$3,781	$10.62	145	$1,580	$10.55	91	657	7.22
California	115	855	7.43	131	1,310	10.00	610	3,610	5.92
Georgia	3,089	23,377	7.57	3,447	26,816	7.78	4,074	24,674	6.06
Missouri	16	160	10.00	....	......	....	28	280	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	400	3,287	8.22
Utah	....	......	....	....	......	....	2,500	31,250	12.50
Virginia	6,228	53,069	8.52	7,881	69,924	8.87	4,275	52,853	12.36
West Virginia	10	80	8.00	....	......	....	....	......	....
Total	9,935	82,278	8.28	11,771	100,289	8.52	11,995	116,722	9.73

State.	1902.			1903.		
	Quantity.	Value.	Average value per ton.	Quantity.	Value.	Average value per ton.
	Long tons.			*Long tons.*		
Arkansas	82	$422	$5.15	....	....	....
California	846	10,175	12.03	16	$116	$7.25
Georgia	3,500	20,830	5.95	500	2,930	5.86
South Carolina	8	40	5.00	25	263	10.52
Utah	....	....	....	483	2,415	5.00
Virginia	3,041	29,444	9.68	1,801	19,611	10.89
Total	7,477	60,911	8.15	2,825	25,335	8.97

In the year 1903 five States contributed manganese ores. Montana and Arkansas, which were reported active in 1902, furnished no ore, but Utah again supplied manganese ores. The chief sources of the mineral in this country, viz, the States of Virginia, Georgia, and Arkansas, showed a falling off. Utah has some deposits of manganese ores which may in the future supply more ore than has been produced heretofore.

Of the 1903 total 1,801 tons, or 64 per cent, came from Virginia, 500 tons from Georgia, and 483 tons from Utah; with these exceptions the quantities mined were small.

The table below shows the production of manganese ores in the States of Virginia, Georgia, Arkansas, and other States, the total production for the United States, and the total value for the years 1880 to 1903, as well as the totals for the twenty-four years covered.

Production of manganese ores in the United States, 1880–1903.

[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	854	7,477	60,911
1903	1,801	500	....	524	2,825	25,335
Total for 24 years	192,868	72,144	49,404	25,919	340,335	3,244,981

PRODUCTION OF MANGANIFEROUS IRON ORES.

As has been the case in former reports the quantity of manganiferous iron ore mined has been included in the iron-ore statistics, but is briefly outlined here.

In the Lake Superior region considerable quantities of iron ores are mined which contain from a fraction of 1 per cent up to 20 per cent or more of manganese, and ores from the same deposit may be marketed as iron ore, or as manganiferous iron ore, which is used in the production of spiegeleisen. It is impossible to indicate clearly the quantities of such manganiferous iron ores as are employed in the production of spiegeleisen from those which form integral parts of the blast furnace charge in the manufacturing of pig iron.

The Colorado ores usually carry a higher percentage of manganese than the Lake Superior ores, and though some of these are also used in the manufacture of spiegeleisen, the bulk are employed as flux by the smelters.

The production of this class of iron ore by States in 1902 and 1903, together with the value of the same, is given in the annexed table:

Production, percentage of manganese, and total and average value of manganiferous iron ores in 1902 and 1903.

Locality.	1902.				1903.			
	Quantity.	Percentage of manganese.	Reported total value at mines.	Average value per ton.	Quantity.	Percentage of manganese.	Reported total value at mines.	Average value per ton.
	Long tons.				*Long tons.*			
Colorado	13,275	18 to 32	$52,371	$3.95	14,856	Not given.	$55,710	$3.75
Lake Superior region	884,939	1 to 10	1,946,255	2.20	566,835	1 to 23	1,511,557	2.67
Virginia	3,000	Not given.	3,000	1.00	2,802	Not given.	4,483	1.60
Total	901,214	1 to 32	2,001,626	2.22	584,493	1 to 23	1,571,750	2.69

The yearly quantity of this character of ore, its total valuation, and the average value per ton from 1889 to 1903, inclusive, are given in the following table:

Production of manganiferous iron ores in the United States, 1889–1903.

[Maxima in italics.]

Year.	Quantity.	Value.	Average value per ton.
	Long tons.		
1889	83,434	$271,680	$3.2
1890	61,863	231,655	3.7
1891	132,511	314,099	2.3
1892	153,373	354,664	2.3
1893	117,782	283,228	2.4
1894	205,488	408,597	1.
1895	125,729	233,998	1.
1896	388,712	726,413	2.
1897	202,304	343,784	1.
1898	287,810	429,302	1.
1899	761,845	1,147,047	1.
1900	377,577	1,087,314	2.
1901	574,489	1,475,084	2.
1902	*901,214*	*2,001,626*	2.
1903	584,493	1,571,750	2.

ARGENTIFEROUS MANGANIFEROUS IRON ORES.

In mining the silver ores of Lake County, Colo., a large quantity mineral is obtained too low in the precious-metal content to make valuable on that account (the limit being usually taken at about $ per ton), and it is used as a flux by the smelters. This ore has be considered as an iron ore and is included in that report, but the qua tities obtained annually from 1889 to 1903, inclusive, together w their valuation will be found in the following table:

Production of manganiferous silver ores in the United States, 1889–1903.

[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
1903	179,205	649,727	3.63

[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.

MANGANIFEROUS ZINC ORES.

In the manufacture of zinc from ores mined in northern New Jersey a clinker is obtained containing iron and manganese, which is used in the production of spiegeleisen. The annual quantity of this class of material contributed from the years 1889 to 1903, inclusive, as well as the total and average value of the same, will be found in the following table:

Production of manganiferous zinc ore residuum in the United States, 1889–1903.

[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	30,585	.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	52,811	1.00
1902	65,246	65,246	1.00
1903	73,264	73,264	1.00

[a] Estimated.

PRODUCTION OF MANGANESE ORES AND MANGANIFEROUS IRON ORES.

The following table presents the production of ores carrying different percentages of manganese mined in the United States in the years 1901, 1902, and 1903, together with their average value per ton:

Production of manganese ores and manganiferous ores in the United States in 1901, 1902, and 1903.

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	7,477	$60,911	$8.15
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	1,168,069	3,035,881	2.60

Kind of ore.	1903.		
	Quantity.	Value.	Average value per ton.
	Long tons.		
Manganese ores	2,825	$25,335	$8.97
Manganiferous iron ores	584,493	1,571,750	2.69
Manganiferous silver ores	179,205	649,727	3.63
Manganiferous zinc residuum [a]	73,264	73,264	1.00
Total	839,787	2,320,076	2.76

[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.

ARKANSAS.

The State of Arkansas was at one time the third State in importance as a producer of manganese ore in the United States, the deposits of this mineral being found in the vicinity of Batesville and Cushman, Independence County, in the northern central part of the State. Although the ore bodies encountered are often high in manganese, they are expensive to mine and usually contain considerable percentages of phosphorus, which makes them undesirable for use in the manufacture of steel. These facts, taken in connection with the limited transportation facilities, account for the gradual decline of the industry from 6,708 long tons in 1892 until in 1903 the production was given as nil. The accompanying table is, however, inserted to show the quantities of manganese ore contributed by the Batesville district from 1850 to date:

Production of manganese in the Batesville district of Arkansas from 1850 to 1903, 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
1903	....do	None.
Total		49,974

CALIFORNIA.

Small quantities of manganese ore are mined in California, and are usually sent to the chlorination works, the 1902 output of 846 tons being the largest recorded. In 1903, however, but 16 tons were reported. The table below shows the annual record from 1874 to 1903, inclusive, the total being 11,347 tons:

Total production of manganese ores in California, 1874–1903.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1874 to 1888	6,000	1897	484
1889	53	1898	541
1890	386	1899	115
1891	705	1900	131
1892	....	1901	610
1893	400	1902	846
1894	278	1903	16
1895	525	Total	11,374
1896	284		

COLORADO.

In mining the silver ores of this State considerable quantities of ore are obtained which contain varying amounts of iron, manganese, and silver. When the percentage of the last metal is too small to make the mineral valuable as a silver ore, that is, to pay the smelting charges and have a sufficient value remaining as reimbursement for mining expenses (say $12 per ton or less), it has not been considered as a silver ore, but it is valued on account of its iron and manganese content as a flux in the smelters, although the silver may somewhat augment this value. When the ore is sufficiently high in manganese, some of it is utilized in the manufacture of spiegeleisen, the quantity so reported in the year 1903 being 14,856 long tons, the remainder, 179,205 tons, going to the smelters for fluxing purposes.

The following table shows the amount of the two classes of manganiferous ores mentioned above which have been mined in Colorado from 1889 to 1903, inclusive:

Production of manganiferous ores in Colorado, 1889–1903.

Ore.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.
	Long tons.	*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	9,072
Manganiferous silver ores	64,987	51,840	79,511	62,309	54,462	30,187	53,506	137,597
Total....................	67,062	51,840	80,475	65,409	60,228	37,209	66,970	146,669

Ore.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Manganiferous iron ores used for producing spiegeleisen ..	16,519	18,848	29,355	43,303	62,385	13,275	14,856
Manganiferous silver ores.....	149,502	99,651	79,855	188,509	228,187	194,132	179,205
Total	166,021	118,499	109,210	231,812	290,572	207,407	194,061

GEORGIA.

The two principal manganese districts in this State are the Cartersville, the only one active in late years, and the Cavespring. The quantity mined in 1903, 500 long tons, is the smallest recorded since 1874, except in 1883 and 1884, when no output was reported. The total quantity mined from 1866 to 1903, inclusive, was 92,094 long tons, the annual production being given in the following table:

Production of manganese ores in Georgia, 1866–1903.

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	1903	500
1888	5,568	Total	92,094
1889	5,208		

a None reported.

VIRGINIA.

This State has been the principal producer of manganese ore in the United States, the bulk being obtained from the Crimora mine, in Augusta County, located near the railroad station of the same name. The maximum output was 20,567 long tons in 1886. In 1903 only 1,801 tons were mined, the minimum output reported with the exception of the years 1894 and 1895.

The greater portion of the ore mined was used in chemical works, etc., the demand of steel works for ferro-manganese being met by imports of manganese ores.

The total production of the State of Virginia from 1880 to 1903, inclusive, is 192,868 long tons, and the annexed table shows the yearly output.

Production of manganese ores in Virginia, 1880–1903.

[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	1903	1,801
1891	16,248	Total	192,868
1892	6,079		

IMPORTS OF MANGANESE ORES.

As spiegeleisen and ferro-manganese, which are both manufactured from manganese ores and manganiferous ores, are used in the production of steel, the limited supply of native ore is largely augmented by that imported from foreign countries. On most of this no duty is levied. The quantity of manganese ore brought in during the year ending December 31, 1903, as reported by the Bureau of Statistics, was 146,056 long tons, valued at $1,278,108, or $8.75 per ton, as against 235,576 long tons imported in 1902, which were valued at $1,931,282, or $8.20 per ton. This is a decline of 89,520 long tons, or 38 per cent.

While there was a falling off in the quantity of manganese ore mined in the United States and also of the importation of ore, the amount of ferro-manganese and spiegeleisen imported increased from 69,034 long tons in the fiscal year 1902 to 175,687 tons in 1903.

The principal foreign source of manganese ore was Brazil, which contributed 76,910 long tons, or over one-half the total. The other important countries are India, Cuba, Russia, Chile, Germany, and Spain, ranking in the order named.

The following table, prepared from data furnished by the Bureau of Statistics of the Department of Commerce and Labor, shows the imports of manganese ore by countries into the United States in the years 1899 to 1903, inclusive, together with the valuations for the same:

Imports of manganese ores into the United States during the calendar years 1899, 1900, 1901, 1902, and 1903, by countries.

Country.	1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Brazil	28,115	$299,877	54,451	$590,825	48,029	$460,024
Russia, Black Sea	73,397	598,644	132,121	812,592	32,600	224,798
British East Indies	17,950	54,471	10,650	30,787	11,000	40,148
Cuba	16,359	221,785	20,582	259,348	21,627	307,084
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
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
Japan	4,492	31,657	5,338	44,707	5,985	52,443
France	2,953	21,080				
Germany	1,274	34,927	1,696	43,025	4,184	76,827
United Kingdom	134	6,697	156	7,466	468	10,563
French West Indies			65	650		
Greece	3,030	10,526	50	897		
Quebec, Ontario, etc			39	1,100	468	3,669
Nova Scotia, New Brunswick, etc	78	2,586	19	1,114	29	1,110
Austria-Hungary			10	427		
Spain					6,050	38,947
Netherlands					29	763
Total	188,349	1,584,528	256,252	2,042,361	165,722	1,486,573

Imports of manganese ores into the United States during the calendar years 1899, 1900, 1901, 1902, and 1903, by countries—Continued.

Country.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Brazil	102,550	$1,006,969	76,910	$738,885
Russia, Black Sea	3,338	24,581	1,596	15,565
Russia, Baltic and White seas			3,980	39,800
British East Indies	64,170	352,487	35,960	226,796
Cuba	36,294	285,571	17,721	111,670
Chile			3,451	25,555
Colombia	700	3,385		
Turkey in Europe	12,609	88,979		
Japan	2,481	37,064	400	10,593
Germany	2,155	68,241	2,837	77,985
United Kingdom	451	10,814	893	23,138
Quebec, Ontario, etc	140	820	3	303
Nova Scotia, New Brunswick, etc	59	2,311	35	1,395
Austria-Hungary			1	85
Spain	10,464	48,098	2,244	5,836
Belgium	165	1,962	25	552
Total	235,576	1,931,282	146,056	1,278,108

An examination of the table shows that in earlier years Russia has been the main reliance. The extent of these Russian deposits was indicated in the report for the year 1897, and there are undoubtedly large reserves obtainable from the Sharopan district; but in 1903 Russia's contribution to the United States was comparatively unimportant.

An examination of the importation of manganese ores in 1903 by customs districts shows that the greater portion came through the port of Baltimore, viz: 115,701 long tons, or 79 per cent of the total, the remainder being brought in via Mobile, Ala.; New Orleans, La.; New York, N. Y.; Perth Amboy, N. J.; Philadelphia, Pa.; Newport News, Va.; Chicago, Ill.; Pittsburg, Pa.; Boston, Mass.; Huron, Mich., and a few scattering ports.

The table below, prepared by the Bureau of Statistics of the Department of Commerce and Labor, shows the importations by customs districts from 1899 to 1903, inclusive.

Manganese ore imported into the United States during the calendar years 1899, 1900, 1901 1902, and 1903, by customs districts.

Customs district	1903.		1902.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Philadelphia, Pa	933	$25,600	1,007	$30,927	24,396	$188,869
Baltimore, Md	115,701	999,835	200,434	1,583,303	120,579	1,004,750
New York, N. Y	3,893	72,091	4,287	77,978	8,103	110,979
Perth Amboy, N. J	2,244	5,836				
Pittsburg, Pa	17	1,459	10	850	40	2,994
Newport News, Va	613	18,332	53	1,616	26	562
Chicago, Ill	153	6,397	116	4,874	48	2,392
Boston, Mass	6	408	32	1,450	25	691
New Orleans, La	4,750	34,170				
Pensacola, Fla			5,339	46,281	8,935	127,159
Mobile, Ala	17,721	111,670	24,158	183,157	3,100	44,100
Huron, Mich	3	303	30	240	396	3,170
Champlain, N. Y			30	240	72	499
All others	22	2,007	80	366	2	108
Total	146,056	1,278,108	235,576	1,931,282	165,722	1,486,573

Customs district.	1900.		1899.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Philadelphia, Pa	80,333	$726,545	90,583	$655,061
Baltimore, Md	161,932	1,134,823	80,006	739,547
New York, N. Y	13,883	176,944	14,762	152,959
Norfolk, Va			2,901	32,248
Pittsburg, Pa	25	1,578	44	2,473
Newport News, Va	15	568	26	1,351
Chicago, Ill			16	595
Boston, Mass	1	24	5	116
Passamaquoddy, Me	2	30	4	82
All others	61	1,849	2	96
Total	256,252	2,042,361	188,349	1,584,528

In order to illustrate the dependence of the United States on foreign sources of manganese ores, the following table has been prepared, showing the annual domestic production and value of manganese ores, together with similar data in regard to the importations. This will show that in the 15 years, from 1889 to 1903, inclusive, the total amount of manganese ore mined was 191,639 long tons, valued at $1,721,294, an average per year of 12,776 tons, valued at $114,753. During the same period 1,583,006 tons of manganese ores were imported, valued at $14,306,540, an average per annum of 105,534 tons, valued at $953,769. From this table it will be seen that the total domestic production in 15 years has been exceeded on two occasions by the importations in a single year.

Relative quantities and values of domestic and imported manganese ores, 1889–1903.

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	7,477	60,911	235,576	1,931,282
1903	2,825	25,335	146,056	1,278,108
Total for 15 years	191,689	1,721,294	1,583,006	14,306,540
Average for 15 years	12,776	114,753	105,534	953,769

CONSUMPTION OF DOMESTIC AND IMPORTED METALLIC MANGANESE.

The consumption of metallic manganese, either as ferro-manganese or as alloyed with iron in spiegeleisen, includes that which is imported from foreign countries and that which is manufactured in the United States, the manufacture of the richer alloy, ferro-manganese, being mainly from imported ores.

On page 143 of Mineral Resources of the United States for 1902 the consumption of metallic manganese in the manufacture of various classes of steel is given and from this an estimate is possible of the approximate quantity of manganiferous alloys used in the United States during the year. The Bureau of Statistics reports that during the calendar year 1903, there were imported into the United States 41,518 tons of ferromanganese and 122,016 tons of spiegeleisen, and the domestic statistics collected by the American Iron and Steel Association show that during the same time there were produced by the blast furnaces of the United States 156,700 tons of spiegeleisen and 35,961 tons of ferromanganese, a total of imported and domestic metal of 356,195 long tons.

The largest production of domestic spiegeleisen and ferromanganese was in the year 1901 when 291,461 tons were reported, but in 1903 the total was only 192,661 long tons. In the following table will be found the annual production of domestic spiegeleisen and ferromanganese in the United States from 1893 to 1903, inclusive, compiled from the reports of the American Iron and Steel Association.

Production of domestic spiegeleisen and ferromanganese, calendar years 1893–1903.

Year.	Quantity.	Year.	Quantity.
	Long tons.		Long tons.
1893	81,118	1899	219,768
1894	120,180	1900	255,977
1895	171,724	1901	291,461
1896	131,940	1902	212,981
1897	173,695	1903	192,661
1898	213,769		

From the reports of the Bureau of Statistics the table below has been prepared to show the imports of ferromanganese and spiegeleisen into the United States for the fiscal years ending June 30, 1884 to 1903, inclusive, together with separate data of both metals for the years 1898 to 1903, inclusive. From this table it will be seen that the maximum importation was in the year ending June 30, 1903, when 175,687 tons, valued at $4,866,760, were imported.

Imports of ferromanganese and spiegeleisen for fiscal years ending June 30, 1884–1903.

Year.	Ferromanganese.	Spiegeleisen.	Total.	
			Quantity.	Value.
	Long tons.	Long tons.	Long tons.	
1884			94,210	$2,353,368
1885			65,406	1,587,108
1886			99,426	2,188,363
1887			150,205	3,327,128
1888			108,973	2,368,600
1889			93,032	1,757,035
1890			108,771	3,032,006
1891			54,239	1,556,969
1892			55,080	1,347,364
1893			49,157	1,273,463
1894			11,579	290,840
1895			8,127	284,409
1896			66,608	1,632,466
1897			11,301	328,328
1898	6,346	10,108	16,454	491,398
1899	10,392	3,615	14,007	518,756
1900	10,684	13,615	24,299	1,178,098
1901	8,995	16,308	25,303	952,144
1902	37,618	31,416	69,034	2,140,753
1903	53,121	122,566	175,687	4,866,760

PRODUCTION OF MANGANESE ORES IN FOREIGN COUNTRIES.

As the most of the manganese ores used in the United States are imported from foreign countries, it will be of interest to refer briefly to the principal producers of this mineral.

CANADA.

Manganese ore has been obtained in small amounts in the Provinces of Nova Scotia and New Brunswick, but figures of production for the year 1903 are as yet unobtainable. The quantity of ore mined in the years 1886 to 1902, inclusive, together with the total value and the average value per ton for each year, is given in the following table:

Production of manganese ore in Canada, 1886–1902.

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
1901	440	4,820	10.95
1902	84	2,774	33.02

[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.

The geological survey of Canada supplies the figures showing the quantity and value of the exports of manganese from 1873 to 1902 given in the following table. These figures apparently show that there are sources of manganese ore which have not as yet been officially located.

Exports of manganese ore from Canada, 1873–1903.

Year.	Nova Scotia.		New Brunswick.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1873	....	....	1,081	$20,192	1,081	$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	184	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	$\frac{3}{16}$	3	108$\frac{3}{16}$	6,351
1896	123$\frac{1}{8}$	3,975	....	....	123$\frac{1}{8}$	3,975
1897	15$\frac{1}{4}$	1,166	....	....	15$\frac{1}{4}$	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
1903	....	....	....	....	135	1,889

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.

In the report for 1902 there appears a summary of the manganese deposits of Cuba which have thus far been exploited, practically all of which are found in the southeastern section of the island.

As far as can be learned the only mines active in 1903 were those of the Ponupo Mining and Transportation Company in the Province of Santiago de Cuba, shipments being made from the port of Santiago. In the year 1903 the production of manganese ores from the Ponupo mines was 20,349 long tons, and the shipments 18,795 tons.

The following table gives the annual exports of manganese ore from the Santiago district of Cuba for the years 1888 to 1903, inclusive:

Exports of manganese ore from Santiago district, Cuba, 1888–1903.

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	1903	18,795

PANAMA.

There are important deposits of manganese ore in the Nombre de Dios district of Panama, but no manganese ore was reported as mined in the year 1903.

BRAZIL.

Brazil is at present the principal contributor of manganese ore to the United States, the greater portion being obtained in the Minas Geraes district, and a relatively small quantity from the Nazareth district. A summary of these deposits was given in the 1902 report.

No official data as to the shipments in 1903 are obtainable, but in the following table will be found the exports of manganese ore from Brazil from 1896 to 1902, inclusive:

Exports of Brazilian manganese ore, 1896–1902.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1896	14,710	1900	[a] 127,348
1897	14,370	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 occur in most of the provinces of Chile, but those which are actively worked are in the provinces of Atacama and Santiago.

In 1902 the manganese ore exported from Coquimbo was 12,990 metric tons, valued at $389,700 Chilean dollars ($142,241).

The following table shows the exports of Chilean manganese ores from 1885 to 1902, inclusive, together with the values in some of these years:

Exports of Chilean manganese ores, 1885–1902.

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	1902	a 12,785	142,241

a From Coquimbo.

GREAT BRITAIN.

A small amount of manganiferous iron ore is obtained in Great Britain, the quantity mined in 1903 being 818 long tons. The following table gives the production and value of manganiferous iron ores in the United Kingdom from 1884 to 1903, inclusive:

Production and value of manganiferous iron ores in the United Kingdom, 1884–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1884	909	$6,921	1894	1,809	$3,562
1885	1,688	11,669	1895	1,273	3,323
1886	12,763	52,722	1896	1,080	2,963
1887	13,777	58,772	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	3,319
1893	1,336	3,688	1903	818	....

a Estimated.

BELGIUM.

Manganiferous iron ores are obtained in Belgium, the amount mined in 1902 being reported as 14,440 metric tons, valued at 187,300 francs ($36,149).

The annexed table gives the annual production and value of manganiferous iron ore in Belgium from 1880 to 1902, inclusive:

Production of manganiferous iron ores in Belgium, 1880–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Metric tons.			*Metric tons.*	
1880	700	$772	1892	16,775	$40,202
1881	770	772	1893	16,800	38,798
1882	845	338	1894	22,048	53,596
1883	820	791	1895	22,478	55,250
1884	750	724	1896	23,265	66,589
1885	....	....	1897	28,372	66,141
1886	750	1,737	1898	16,440	40,820
1887	12,750	30,079	1899	12,120	30,245
1888	27,787	62,725	1900	10,820	25,158
1889	20,905	47,864	1901	8,510	21,384
1890	14,255	33,968	1902	14,440	36,149
1891	18,498	49,022			

FRANCE.

Manganese ores are mined in two departments of France, in the southern part of L'Ariege and in the western and central sections of Saone and Loire, the production in 1902 being 12,536 metric tons, valued at 327,600 francs ($63,227).

The following table gives the production and value of manganese ores produced in France from 1886 to 1902, inclusive, together with the average value per ton:

Production and value of manganese ores in France, 1886–1902.

Year.	Quantity.	Value.	Value per ton.	Year.	Quantity.	Value.	Value per ton.
	Long tons.				*Long tons.*		
1886	7,555	$53,099	$7.03	1895	30,385	$177,698	$5.85
1887	11,932	50,501	4.23	1896	30,797	179,297	5.82
1888	10,873	60,757	5.59	1897	36,612	200,720	5.48
1889	9,842	59,000	5.99	1898	31,396	160,383	5.11
1890	15,731	89,517	5.69	1899	39,270	215,581	5.49
1891	15,101	90,316	5.98	1900	28,534	164,050	5.75
1892	31,894	205,074	6.43	1901	21,952	91,699	4.18
1893	37,406	290,073	7.75	1902	12,338	63,227	5.12
1894	32,239	192,264	5.96				

GERMANY.

The Kingdom of Prussia contributes the major portion of the manganese ore obtained in Germany, but this is more strictly speaking a manganiferous iron ore, the quantity mined in 1903 being 47,110 metric tons, valued at 463,000 marks ($110,194). The production of true manganese ore from other provinces of Germany was 884 metric tons, valued at 57,000 marks ($13,566).

The annual production of manganese ores mined in Germany from 1890 to 1903, inclusive, and the production and value of manganiferous iron ores in Prussia from 1881 to 1902, inclusive, the later years being furnished by Mr. E. Schrödter, of Düsseldorf, are as follows:

Production of manganese ores in Germany, 1890–1903.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1890	41,180	1897	45,694
1891	89,698	1898	42,669
1892	82,841	1899	60,360
1893	40,057	1900	58,269
1894	43,012	1901	55,796
1895	40,674	1902	49,025
1896	44,350	1903	47,286

Production and value of manganese ores in Prussia, 1881–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1881	10,911	$79,104	1893	88,384	$93,506
1882	4,597	83,745	1894	41,854	94,992
1883	4,502	28,423	1895	39,266	100,832
1884	7,629	43,118	1896	42,925	97,469
1885	14,464	81,302	1897	44,538	98,185
1886	24,649	177,066	1898	41,565	92,060
1887	85,957	228,489	1899	59,425	151,368
1888	26,877	147,250	1900	57,100	157,271
1889	43,311	216,881	1901	54,984	155,652
1890	89,497	174,428	1902	48,110	126,140
1891	86,278	174,624	1903	46,366	110,194
1892	80,892	101,844			

ITALY.

The Kingdom of Italy in 1902 produced 2,477 metric tons of manganese ores, valued at 103,740 lire ($20,022) and 23,113 metric tons of maganiferous iron ore, valued at 276,601 lire ($53,384).

The following table shows the annual production of manganese ores in Italy, together with the value of the same, from 1860 to 1902, inclusive; also of manganiferous iron ores from 1874 to 1883 and from 1892 to 1902, inclusive, except 1895:

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	10,408		
1870	630	8,646		
1871	779	9,798		
1872	1,125	12,311		
1873	3,108	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	98,315
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	6,378	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		
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	2,965	18,052	10,974	25,828
1899	4,287	21,647	29,402	74,449
1900	5,919	29,910	26,377	64,655
1901	2,147	16,052	23,906	58,131
1902	2,438	20,022	22,748	58,384

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

SPAIN.

The manganese ore obtained in Spain comes chiefly from the Province of Huelva, where ores of the carbonate and silicate varieties are obtained. Mr. Carl Doetsch, of Huelva, has supplied the following table of exports of manganese ore from that Province from the year 1859 (the beginning of the industry) to 1903, inclusive:

Exports of manganese ore from the Province of Huelva.

Year.	Metric tons.	Year.	Metric tons.
1859-60	27,398	1883	4,020
1861	1,102	1884	....
1862	6,400	1885	....
1863	18,266	1886	....
1864	20,690	1887	....
1865	24,292	1888	....
1866	31,371	1889	....
1867	41,050	1890	4,720
1868	35,306	1891	3,884
1869	20,646	1892	10,410
1870	17,102	1893	6,394
1871	24,297	1894	7,321
1872	27,055	1895	33,353
1873	15,510	1896	90,821
1874	25,588	1897	103,267
1875	13,350	1898	138,062
1876	6,973	1899	138,419
1877	7,295	1900	129,916
1878	36,475	1901	91,672
1879	4,750	1902	62,944
1880	27,572	1903	54,540
1881	4,823	Total	1,317,054
1882	....		

The distribution of the exports in the years 1899 to 1903, inclusive, was as follows:

Exports of Huelva manganese ores, 1899–1903.

Country.	Quantity.				
	1899.	1900.	1901.	1902.	1903.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Belgium and Luxemburg	127,743	126,482	85,951	57,927	53,429
England	4,842	1,213	918	12	....
France	4,449	2,221	2,361	1,823	1,111
Germany	1,385	....	2,442	3,182	....
Total	138,419	129,916	91,672	62,944	54,540

Mr. Doetsch estimates the total value of the exports in 1903 as 1,500,000 pesetas ($289,500).

From the north of Spain, also, a small amount of manganese ore, estimated at about 1,000 tons per annum, is exported.

PORTUGAL.

Most of the manganese ore mined in Portugal comes from the district of Beja, in the Province of Alentejo, the production of 1901 being reported as 904 metric tons.

AUSTRIA-HUNGARY.

The Kingdom of Austria mines some manganese ore, the quantity produced in 1903, as reported by Prof. Hans Hoefer, being 61,789 metric centners, valued at 128,851 crowns ($26,157).

The following table gives the annual production of manganese ore in Austria from 1876 to 1903, inclusive:

Production of manganese ore in Austria, 1876–1903.

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	1903	6,179

a Including Bosnia.

Professor Hoefer gives the quantity of manganese ore mined in the Kingdom of Hungary in 1903 as 124,895 metric centners, valued at 64,970 crowns ($13,189), and in Bosnia and Herzegovina as 45,374 metric centners, valued at 136,122 crowns ($27,633).

The following tables give the production of manganese ores in Hungary from 1897 to 1903, and in Bosnia and Herzegovina from 1892 to 1903, inclusive:

Production of manganese ore in Hungary, 1897–1903. a

Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*
1897	8,976	1901	4,591
1898	8,055	1902	7,847
1899	5,073	1903	12,490
1900	5,746		

a Ungarisches Statistiches Jahrbuch.

Production of manganese ore in Bosnia and Herzegovina, 1892–1903.

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	a5,260	1902	5,669
1898	a5,235	1903	4,465

a Bosnisches Bureau Montan Abtheilung.

SWEDEN.

The production of manganese ore in Sweden is unimportant, the quantity mined in 1903 being 2,244 metric tons, valued at 36,550 kroners ($9,795).

The following table gives the official statistics of the annual production and value of manganese ores in Sweden from 1888 to 1903, inclusive:

Production of manganese ore in Sweden, 1888–1903.

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	....	1903	2,244	9,795

RUSSIA.

Late official statistics in regard to the production of manganese in Russia, the principal manganese producing country in the world, are difficult to obtain.

According to a report lately presented by Mr. Ethelbert Watts, consul-general of the United States at St. Petersburg, Russia, the ore is mined in the provinces of Perm, Orenburg, Ekaterinoslav, and Kutais (Caucasus). The latter province yields three-fourths of the manganese produced in Russia, and nearly all of it is exported. The total yield of the province in 1901 is given as 375,211 metric tons, a decrease of 286,733 tons compared with the quantity mined in 1900. The exports in 1901 were 355,545 metric tons, as against 461,125 tons in 1900.

The following table shows the production of manganese ore in the different provinces of Russia from 1885 to 1901, inclusive:

Statistics of manganese ores in Russia.[a]

[In poods.]

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	....	....	22,569,085	....	....	....

[a] One long ton equals 62 poods. [b] Exports within Russia not included.

TURKEY.

Turkey has some good manganese deposits which are worked to supply a portion of the foreign demand, none of it being used locally. Mr. Hugh Whittall, of Constantinople, states that the ministry of mines report the exportation of manganese ore from Turkey in the year 1903 as 49,100 metric tons, valued at 66,950 pounds ($325,812).

GREECE.

Greece produces considerable quantities of manganese ore, the quantity reported mined being given as 18,076 metric tons, valued at 542,280 francs, in 1901, and 14,962 metric tons, valued at 448,860 francs, in 1902. A considerable amount of manganiferous iron ore is also obtained.

INDIA.

India in late years has attained considerable prominence as a producer of manganese ores, the greater portion coming from the presidency of Madras. The production of manganese ore in India in 1903, according to the report of Mr. L. Robertson, under secretary to the government of India, was 165,006 long tons, valued at 1,991,117 rupees ($645,123), this year's production being the maximum.

The following table gives the production of manganese ore in India from 1894 to 1903, inclusive, the figures for the earlier years being those of exports.

Exports of manganese ore from British India by sea to other countries, 1894–1903.

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	162,067
1897	73,680	1902 a	157,780
1898 a	60,449	1903 a	165,006

a Production.

JAPAN.

Manganese ores are mined in Japan, but the quantity secured is moderate.

In the following table the first column, taken from the Financial and Economical Annual of Japan, gives the production of manganese ores from 1886 to 1901, inclusive, and the second column, taken from the annual returns of the Empire of Japan (department of finance), shows the exports of this mineral from 1881 to 1903, inclusive, together with the value of the same from 1893 to 1903. As both sets of figures are claimed as official, no attempt at harmonizing is made.

The exports of manganese ores in 1903 are given as 5,571,518 kin, valued at 77,892 yen ($38,791). Of this quantity, 4,065,841 kin were exported from Yokohama, 1,502,047 kin from Kobe, and 3,630 kin from Osaka.

Production and export of manganese ores, Japan, 1881–1903.

Year.	Production.	Exports.	Value of exports.	Year.	Production.	Exports.	Value of exports.
	Long tons.	*Long tons.*			*Long tons.*	*Long tons.*	
1881	....	2	....	1893	15,655	18,510	$106,016
1882	....	156	....	1894	13,007	17,465	99,007
1883	....	151	....	1895	16,679	16,338	97,906
1884	....	125	....	1896	17,482	20,785	136,668
1885	....	123	....	1897	15,031	14,524	102,248
1886	392	404	....	1898	11,207	9,905	77,853
1887	302	312	....	1899	11,049	9,157	76,039
1888	688	813	....	1900	15,430	12,576	111,750
1889	916	945	....	1901	15,858	8,726	93,214
1890	2,526	2,604	....	1902	....	2,625	....
1891	3,142	3,178	....	1903	....	3,258	38,791
1892	4,891	4,948	....				

JAVA.

Manganese ores are exploited in the regencies of Pengasin and Mangolaen, but no late reports are at hand. In 1899 the quantity mined is given as 1,388 metric tons.

NEW ZEALAND.

In 1902 no manganese ore was mined in New Zealand, but in 1901 208 long tons were produced, valued at £614 ($2,988).

AUSTRALIA.

NEW SOUTH WALES.

No manganese ore was mined in this province in 1902, but in 1901 there was a production of 12 tons of manganese.

QUEENSLAND.

In 1902 Queensland supplied 4,600 tons of manganese ore valued at £16,989 ($82,677). The following table shows the production and value of manganese ore in Queensland from 1881 to 1902, inclusive:

Production and value of manganese ores in Queensland, 1881–1884 and 1889–1902.

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	785	13,775
1891	10	126	1900	75	998
1892	....	....	1901	218	3,869
1893	....	....	1902	4,600	82,677

SOUTH AUSTRALIA.

There was exported from South Australia to Queensland, in the year 1902, 18$\frac{5}{20}$ tons of manganese ore, valued at £62 ($302).

WORLD'S PRODUCTION OF MANGANESE ORES.

Contemporaneous data of the production of manganese ores in foreign countries can not be secured, but in the following table are presented the latest reliable statistics which were obtainable, together with the year which the figures represent. The tons are either long or metric, except in the case of Canada, where the short ton is used.

World's production of manganese ores.

Country.	Year.	Production.	Country.	Year.	Poduction.
North America:		*Tons.*	Europe—continued:		*Tons.*
United States	1903	2,825	Italy	1902	2,477
Canada[a]	1903	135	Portugal	1901	904
Cuba[a]	1903	18,795	Russia	1900	884,200
South America:			Spain	1903	55,540
Brazil[a]	1902	156,269	Sweden	1903	2,244
Chile[a]	1902	12,990	Turkey[a]	1903	49,100
Europe:			Asia:		
Austria	1903	6,179	India	1903	165,006
Bosnia and Herzegovina	1903	4,537	Japan	1901	16,298
Hungary	1903	12,490	Java[a]	1899	1,888
France	1902	12,536	Oceania:		
Germany	1903	47,994	Queensland	1902	4,600
Greece	1902	14,962	South Australia	1902	18

[a] Exports.

GOLD AND SILVER.

PRODUCTION.

The total statistics of the production of gold and silver for 1903 are furnished, as heretofore, by the Director of the Mint, but the statistical canvass made by the United States Geological Survey resulted in some differences in the distribution of the product among the several States and Territories.

During the calendar year 1903 the United States produced 3,560,000 fine ounces of gold, valued at $73,591,700, a decrease of $6,408,300, or 8.01 per cent, as compared with the production of 1902.

Of the 21 States and Territories yielding gold in 1903, 11 showed an increase in production, Nevada leading with an increase of $492,700, or 17.02 per cent. Alaska, which led in increase in 1902, was second in 1903, with an increase of $268,900. Kansas and Tennessee, with productions valued, respectively, at $9,700 and $800, reported for the first time in 1903. The other States and Territories showing gains in 1903 were as follows: Arizona, $245,300; Utah, $102,900; Idaho, $95,400; Montana, $38,300; Virginia, $10,400; Washington, $7,700, and Alabama, $1,900.

The greatest decrease in production in 1903 was in Colorado, where the production fell off $5,928,600, or 20.82 per cent. California was second in amount of decrease in 1903, falling off $687,600. Decreases were also noted in the following States and Territories: Oregon, $526,500; New Mexico, $286,500; South Dakota, $138,700; Georgia, $35,800; Wyoming, $35,200; South Carolina, $21,200; North Carolina, $20,200, and Maryland, $2,000.

The silver yield of the United States for 1903 amounted to 54,300,000 fine ounces, with a coining value of $70,206,060 and a commercial value of $29,322,000, a decrease in quantity of 1,200,000 fine ounces, or 2.16 per cent.

Of the 21 States and Territories producing silver in 1903, 11 showed increased production. Nevada, which led in increase of production of silver in 1902, held the same position in 1903, showing an increase of 1,304,300 fine ounces, or 34.82 per cent. This great increase is due to further developments in the rich Tonopah district in Nye County. The following States and Territories also showed gains in production in 1903 over 1902: Idaho, 652,600 ounces; Utah, 365,100 ounces; Arizona, 344,000 ounces; Alaska, 51,600 ounces; California, 30,700 ounces; Oregon, 24,700 ounces; Texas, 8,200 ounces; Virginia, 3,600 ounces; and Tennessee, 700 ounces. Kansas reported silver for the first time in 1903, having a production of 97,400 ounces. The greatest decrease in the production of silver in 1903 was in Colorado and amounted to 2,685,800 fine ounces. Alabama, which reported 100 fine ounces of silver in 1902, reported no production in 1903. Other decreases were as follows: Montana, 601,500 ounces; Washington, 324,500 ounces; New Mexico, 276,500 ounces; South Dakota, 119,000 ounces; Michigan, 60,800 ounces; North Carolina, 9,900 ounces; and Wyoming, 4,800 ounces.

The total value of the production of the precious metals by the United States in 1903 (silver at commercial value) amounted to $102,913,700, a decrease of $6,501,300, or 5.94 per cent, from the yield of 1902.

The following table shows the production of gold and silver in the United States from 1792 to 1903, inclusive:

Production of gold and silver in the United States, 1792–1903.

[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

Production of gold and silver in the United States, 1792–1903—Continued.

Year.	Total.	Gold.	Silver (coining value).
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
1890	103,309,645	32,845,000	70,464,645
1891	108,591,565	33,175,000	75,416,565
1892	115,101,000	33,000,000	82,101,000
1893	113,531,000	35,955,000	77,576,000
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	151,757,575	80,000,000	71,757,575
1903	143,797,760	73,591,700	70,206,060

The following table shows the production of gold in the United States in 1902 and 1903 and the increase or decrease in 1903, by States and Territories:

Production of gold in the several States and Territories in 1902 and 1903, and the increase or decrease of the production of each in the latter year.

State or Territory.	Value.			
	1902.	1903.	Increase.	Decrease.
Alabama	$2,500	$4,400	$1,900	
Alaska	8,345,800	8,614,700	268,900	
Arizona	4,112,300	4,357,600	245,300	
California	16,792,100	16,104,500		$687,600
Colorado	28,468,700	22,540,100		5,928,600
Georgia	97,800	62,000		35,800
Idaho	1,475,000	1,570,400	95,400	
Kansas		9,700	9,700	
Maryland	2,500	500		2,000
Montana	4,373,600	4,411,900	38,300	

Production of gold in the several States and Territories in 1902 and 1903, etc.—Continued.

State or Territory.	Value.			
	1902.	1903.	Increase.	Decrease.
Nevada	$2,895,300	$3,388,000	$492,700	
New Mexico	531,100	244,600		$286,500
North Carolina	90,700	70,500		20,200
Oregon	1,816,700	1,290,200		526,500
South Carolina	121,900	100,700		21,200
South Dakota	6,965,400	6,826,700		138,700
Tennessee		800	800	
Utah	3,594,500	3,697,400	102,900	
Virginia	3,100	13,500	10,400	
Washington	272,200	279,900	7,700	
Wyoming	38,800	3,600		35,200
Total	80,000,000	73,591,700	1,274,000	7,682,300
Net decrease				6,408,300

The following table shows the production of silver in the United States in 1902 and 1903, and the increase or decrease in 1903, by States and Territories:

Production of silver in the several States and Territories in 1902 and 1903, and the increase or decrease of the production of each in the latter year.

State or Territory.	Weight.			
	1902.	1903.	Increase.	Decrease.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*
Alabama	100			100
Alaska	92,000	143,600	51,600	
Arizona	3,043,100	3,387,100	344,000	
California	900,800	931,500	30,700	
Colorado	15,676,000	12,990,200		2,685,800
Georgia	400	400		
Idaho	5,854,800	6,507,400	652,600	
Kansas		97,400	97,400	
Michigan	110,800	50,000		60,800
Montana	13,243,800	12,642,300		601,500
Nevada	3,746,200	5,050,500	1,304,300	
New Mexico	457,200	180,700		276,500
North Carolina	20,900	11,000		9,900
Oregon	93,300	118,000	24,700	
South Carolina	300	300		
South Dakota	340,200	221,200		119,000
Tennessee	12,300	13,000	700	
Texas	446,200	454,400	8,200	
Utah	10,831,700	11,196,800	365,100	
Virginia	5,900	9,500	3,600	
Washington	619,000	294,500		324,500
Wyoming	5,000	200		4,800
Total	[a] 55,500,000	[b] 54,300,000	2,882,900	4,082,900
Net decrease				1,200,000

[a] Commercial value, $29,415,000; coining value, $71,757,575.
[b] Commercial value, $29,322,000; coining value, $70,206,060.

The following table shows the approximate distribution of the production, by States and Territories, of gold and silver in the United States in 1903:

Approximate distribution of the production of gold and silver in the United States for the calendar year 1903, 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	213	$4,400				$4,400
Alaska	416,788	8,614,700	143,600	$185,665	$77,544	8,692,244
Arizona	210,799	4,357,600	3,387,100	4,379,281	1,829,034	6,186,634
California	779,057	16,104,500	981,500	1,204,364	503,010	16,607,510
Colorado	1,090,376	22,540,100	12,990,200	16,795,410	7,014,708	29,554,808
Georgia	3,000	62,000	400	517	216	62,216
Idaho	75,969	1,570,400	6,507,400	8,413,608	3,513,996	5,084,396
Kansas	468	9,700	97,400	125,981	52,596	62,296
Maryland	24	500				500
Michigan			50,000	64,646	27,000	27,000
Montana	213,425	4,411,900	12,642,300	16,345,600	6,826,842	11,238,742
Nevada	163,892	3,388,000	5,050,500	6,529,939	2,727,270	6,115,270
New Mexico	11,833	244,600	180,700	233,632	97,578	342,178
North Carolina	3,411	70,500	11,000	14,222	5,940	76,440
Oregon	62,411	1,290,200	118,000	152,566	63,720	1,353,920
South Carolina	4,872	100,700	300	388	162	100,862
South Dakota	330,243	6,826,700	221,200	285,996	119,448	6,946,148
Tennessee	38	800	13,000	16,808	7,020	7,820
Texas			454,400	587,507	245,376	245,376
Utah	178,863	3,697,400	11,196,800	14,476,671	6,046,272	9,743,672
Virginia	654	13,500	9,500	12,283	5,130	18,630
Washington	13,539	279,900	294,500	380,768	159,030	438,930
Wyoming	175	3,600	200	258	108	3,708
Total	3,560,000	73,591,700	54,300,000	70,206,060	29,322,000	102,913,700

The following table shows the distribution of the production of gold and silver in 1903 according to sources of production:

Distribution of the production of gold and silver in the United States for the calendar year 1903 as to the 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	222	15	49		
Alaska	131,862	288,209	180,161		
Arizona	216,584	4,800	1,911,451	195,000	1,300,000
California	596,607	189,122	325,512	144,482	495,927
Colorado	1,069,364	29,025	2,917,326	a 10,343,248	
Georgia	1,989	1,230	1,303		
Idaho	47,506	36,231	872,811	6,042,225	
Maryland	9	22	1		
Michigan					49,991

a Lead and copper ores.

Distribution of the production of gold and silver in the United States, etc.—Continued.

State or territory.	Gold.		Silver.		
	Quartz.	Placer.	Quartz.	Lead ores.	Copper ores.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*
Montana	198,776	23,290	4,091,158	450,303	8,682,543
Nevada	174,428	1,762	5,151,631	465	
New Mexico	7,499	5,544	12,349	104,242	85,365
North Carolina	4,671	438			13,076
Oregon	55,447	10,000	124,599	1,000	
South Carolina	5,092	127	271		
South Dakota	339,803		273,545		
Tennessee		3			
Texas			454,376		
Utah	192,094		361,622	8,258,303	3,195,007
Virginia	216				17,073
Washington	20,593	1,000	156,537	143,614	5,250
Wyoming		401	826		
Total	3,062,762	591,219	16,835,528	25,682,882	13,844,232

The following table shows the production of gold in the famous Cripple Creek district of Colorado for the eleven years from 1893 to 1903, inclusive:

Production of gold in Cripple Creek district, Colorado, 1893–1903.

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
1903	12,967,338
Total	123,831,562

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

Production of gold in the several States and Territories in 1901 and 1902, etc.—Continued.

State or Territory.	Value.			
	1901.	1902.	Increase.	Decrease.
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 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 the United States in 1902, by producing States and Territories:

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).
	Quantity.	Value.	Quantity.	Coining value.	Commercial value.	
	Fine ounces.		*Fine ounces.*			
Alabama	119	$2,500	100	$129	$53	$2,553
Alaska	408,730	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.

[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.*			
Montana	211,571	$4,378,600	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	25,696	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	208,000	1,130,000
California	612,559	205,478	168,582	285,917	22,257
Colorado	1,348,046	31,444	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	16,968,647	28,035,620	12,812,291

a Lead and copper ores.

GOLD AND SILVER IN 1903 BY INDIVIDUAL STATES AND TERRITORIES.

ALASKA.

By Alfred H. Brooks.

PRODUCTION.

The wide fluctuations of the annual production of precious metals in Alaska during the last five years, as shown in the accompanying table, demand explanation. From 1898 to 1900 there was an increase in value of over five and a half million dollars, followed by a falling off in the succeeding year of nearly one and a half millions, which was more than regained in 1902. The output of 1903 shows a still further increase of some $300,000. These facts are presented in greater detail in the following table:

Production of gold and silver in Alaska, 1898–1903.

[As estimated by the Director of the Mint.]

Year.	Gold.		Silver.			Total value (silver at commercial value).
	Quantity.	Value.	Quantity.	Coining value.	Commercial value.	
	Fine ounces.		*Fine ounces.*			
1898	122,137	$2,524,800	92,400	$119,467	$54,516	$2,579,316
1899	264,104	5,459,500	140,100	181,140	84,060	5,543,560
1900	395,271	8,171,000	73,300	94,772	45,446	8,216,446
1901	333,096	6,885,700	47,900	61,931	28,740	6,914,440
1902	403,730	8,345,800	92,000	118,950	48,760	8,394,560
1903	416,738	8,614,700	143,600	185,665	77,544	8,692,244

The production of the quartz mines during this period has not varied from year to year over 20 per cent, and the value of their silver output is so small that it can be disregarded. The fluctuation of the total production is, therefore, a reflection of the status of the placer-mining industry. Moreover, as nearly five-sixths of the gold derived from placers comes from the Seward Peninsula, it is patent that the production of this district is the governing factor in the entire output.

The rapid exploitation of the rich placers at Nome, in 1899 and 1900, especially the easily mined auriferous beach gravels, brought up the total values with a bound, but this was, unfortunately, followed by a reaction; for two favorable seasons sufficed to almost exhaust the beach placers, and to make serious inroads on some of the bonanzas of the shallower creek deposits. This fact, combined with a rich harvest of legal complications which had arisen at Nome, together with a very short and unfavorable season, led to a discouraging falling off of the placers in 1901. Meanwhile, however, the more enterprising operators had recognized the necessity of improving the mining methods, and consequently the building of ditches and the introduction of hydraulic methods had by 1902 gone far enough to bring the production up over the eight million dollar mark again. The same general conditions existed through 1903. Though[a] many extensive plants are being installed and 100 miles or more of ditches are being constructed in the peninsula, but few of these are in operation.

The development of the bed-rock mines is relatively slow, and much the larger part of the lode gold still comes from the famous Treadwell group. In the Juneau district[b] much activity was displayed in lode mining during 1903, and some large properties changed hands. A few small gold mines were in operation in the Ketchikan district and other properties were prospected, but it was on the copper deposits of this region, rather than on the auriferous veins, that the attention of the mining public was centered. Gold-bearing quartz veins have been found in other parts of Alaska, but few of these have been developed so far as to reach a productive stage. Perhaps the most significant feature of lode mining in 1903 was the establishment as a commercial success of the Big Hurrah quartz mine on the Seward Peninsula. This little property, with its ten stamps, represents the only effort at quartz mining in all northern Alaska.

The production of the Seward Peninsula placers is estimated to be about $5,000,000, of which probably three-fifths was taken from the Nome district, one-fifth from Ophir Creek, and the balance from three or four less important camps. Outside of the general activity in ditch construction and the installment of machinery, a very interesting incident of the year was the discovery of considerable gold-bearing gravel in the northeastern[c] part of the peninsula, in the valley of the Inmachuk River.

The Yukon region, including Fortymile, Birch Creek, Rampart, Koyukuk, and the recently discovered Fairbanks district, had an aggregate output for its placers of probably $1,000,000. Most of the camps of this region are so isolated as to make the cost of mining a very large percentage of the production. In only a few instances have extensive mining plants been installed in this field, and most of the gold is taken out in small quantities by more or less primitive methods. The newly discovered Fairbanks[d] district comprises a dozen creeks tributary to the Lower Tanana, from which they are only 15 to 20 miles distant. The auriferous gravels appear to occur in considerable thickness, and the values though not high are fairly uniformly distributed.

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[a] Brooks, Alfred H., Placer mining in Alaska in 1903: Bull. U. S. Geol. Survey No. 225, 1904, pp. 43-59.

[b] Spencer, Arthur C., The Juneau gold belt: Bull. U. S. Geol. Survey No. 225, 1904, pp. 28-42.

[c] Moffit, F. H., The Kotzebue gold placer field of the Seward Peninsula: Bull. U. S. Geol. Survey No. 225, 1904, pp. 74-80.

[d] Prindle, L. M., Gold placers of the Fairbanks district: Bull. U. S. Geol. Survey No. 225, 1904, pp. 64-73.

In the Cook Inlet region steady progress is being made in the installation of hydraulic plants. The Christochina district, lying in the Copper River Basin, in spite of its isolated position, is being developed, but only in a small way. With the settlement of the boundary dispute, the Porcupine[a] district promises to take a new lease of life. The aggregate output of these three camps is probably less than half a million. The discovery of gold placers in the Kobuk Valley made in 1903, though yet of no importance from the standpoint of production, indicates a wider distribution of the gold-bearing areas than had previously been supposed.

ARIZONA.

By V. C. Heikes.

The Territory of Arizona has during the year past held its own in the output of precious metals, and, in fact, shows a slight increase over the preceding year. When the Tombstone mines are unwatered and fully reopened there will be a notable increase and a probability of some return to the production which made Tombstone famous about twenty years ago. The increase will undoubtedly be in gold as well as in silver, as records show the ores produced higher values in gold at the water level, and assays taken lower down showed a considerable increase in the amount of yellow metal to the ton of ore. The tables appended to this chapter are those obtained from returns by producers to the Director of the United States Geological Survey in answer to interrogatories. According to these returns the yield of the Territory in precious metals for 1902 and 1903 was as follows:

Production of gold and silver in the Territory of Arizona in 1902 and 1903.

	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
Gold	131,453	$2,717,133	132,067	$2,729,824
Silver	1,610,564	840,070	2,109,456	1,126,661
Gold increase				$12,691
Silver increase				286,591

Average commercial value of silver in 1902, $0.5216 per ounce; in 1903, $0.5341 per ounce.

[a] Wright, C. W., The Porcupine placer district, Alaska: Bull. U. S. Geol. Survey No. 236, 1904.

The following table shows the distribution of the total gold production of the Territory of Arizona, by counties, in 1902 and 1903:

Production of gold in Arizona in 1902 and 1903, by counties.

County.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
Cochise	20,146	$416,418	18,283	[a]$377,910
Coconino, Gila, and Maricopa	887	18,334	130	[b]2,687
Graham	1,291	26,685	443	[a]9,157
Mohave	2,526	52,212	15,859	[b]327,806
Pima	471	9,736	473	[b]9,777
Pinal	160	3,307	238	[b]4,919
Santa Cruz	18	372	540	[b]11,162
Yavapai	81,931	1,693,514	77,843	[a]1,609,014
Yuma	24,023	496,555	18,258	[a]377,392
Total	131,453	2,717,133	132,067	2,729,824

[a] Decrease. [b] Increase.

The following table gives the production of gold derived from the different kinds of ore treated:

Production of gold in Arizona in 1902 and 1903, by kinds of ore.

Year.	Milling ores.			Smelting ores.		Total.	
	Placer.	Siliceous ores.	Ores cyanided.	Lead ores.	Copper ores.	Fine ounces.	Value.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*		
1902	497	22,033	74,316	8,702	25,905	131,453	$2,717,133
1903	568	22,404	79,639	3,600	25,856	132,067	2,729,824

SUMMARY OF GOLD PRODUCED FROM DIFFERENT SOURCES.

Placer bullion.—The production remains small, Pima County having the largest output, which came mainly from the Greaterville placers, with small amounts from the Horse Shoe Basin in the Quijotoa district. The placers are worked by the Mexicans and Papago Indians during the season of rains affording water for washing operations. The gold is sold to storekeepers, who report yearly the output.

Gold in siliceous ores.—The output of gold is largely from the siliceous ores, and it is found free in quartz and in combination with various ores having small percentages of sulphides. The most notable increase in gold from siliceous ores is found in Mohave County. The decrease in Yuma County was due to the idleness during part of the year of one of the largest gold properties.

Gold ores cyanided.—Yuma, Yavapai, and Mohave counties produce the largest amount of cyanides, which are made mainly from ores directly treated by the cyanide process. The mills of several large properties have found the cyanide process advantageous in the treatment of tailings.

Gold in lead ores.—The largest production of gold from this class of ore has been reported in Yavapai County. The decrease is probably due to the values of gold increasing in the ores carrying copper.

Gold in copper ores.—Yavapai County is credited with the largest output of gold from copper ores. Cochise County is next in importance, and on account of increased smelter facilities in the new town of Douglas, it showed a notable increase over 1902. The other important copper districts report very little gold associated with copper ores.

The following table shows the output of silver in the Territory of Arizona for the years 1902 and 1903, by counties, comparing the two years:

Production of silver in Arizona in 1902 and 1903, by counties.

County.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
Cochise	887,367	$462,851	1,406,815	$751,113
Coconino, Gila, and Maricopa	4,242	2,212	5,265	2,812
Graham	26,048	13,587	13,644	7,287
Mohave	90,494	47,202	54,169	28,931
Pima	2,440	1,273	2,450	1,309
Pinal	18,490	9,644	3,461	1,849
Santa Cruz	98,060	51,148	4,080	2,179
Yavapai	466,874	243,521	602,087	321,575
Yuma	16,549	8,632	17,985	9,606
Total	1,610,564	[a]840,070	2,109,456	[b]1,126,661

[a] Commercial value, $0.5216. [b] Commercial value, $0.5341.

The production of silver in Arizona in 1902 and 1903, by sources, is as follows:

Production of silver in Arizona in 1902 and 1903, by kinds of ore.

Year.	Milling ores.			Smelting ores.		Total.	
	Placer.	Siliceous ores.	Ores cyanided.	Lead ores.	Copper ores.	Fine ounces.	Value.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*		
1902	....	723,025	68,562	177,158	641,819	1,610,564	$840,070
1903	20	1,068,317	50,158	84,757	906,204	2,109,456	1,126,661

SUMMARY OF SILVER PRODUCED FROM DIFFERENT SOURCES.

Placer bullion.—Only 20 ounces of silver was reported from all sources.

Silver in siliceous ores.—The largest output of silver in this class of ore is credited to Cochise County, which had a greatly increased production over 1902. Reports from Yavapai and Mohave counties also show an increase.

Silver in ores cyanided.—Yavapai County reports show that the largest amount of silver is won from ores and tailings treated by cyanide. Mohave and Yuma counties follow in order of production.

Silver in lead ores.—The lead-bearing ores of Yavapai County give up the most silver, with Cochise next, both being credited with an increase over 1902. Yuma County is placed third in the list of silver producers from lead ores. Mohave County shows a notable decrease in production, as do also Pima and Santa Cruz, as compared with the output in 1902.

Silver in copper ores.—Yavapai County has to its credit an increased number of ounces of silver won from copper-bearing ores, the figures showing an increase over 1902. Cochise County is second, and fully doubles its output. The next in importance in the production of silver from copper ores is Graham County.

MINES CHARACTERIZED BY THEIR MAIN PRODUCT.

According to a tabulated list consisting of 183 mines known as producing properties in distinction to mere prospects, only 117 were actual producers in 1903. All the mines that have been idle for several years were excluded from this list. As characterized by their main product, these mines may be specified as follows: 38 copper, 7 lead, 55 gold, and 17 silver.

The mining of copper ore is the main industry in the several following counties: Graham, credited with 10 properties; Gila, 8; Yavapai, 7; Cochise, 5; Coconino, 2; Pima, 2; Pinal, 2; Santa Cruz, 1; Yuma, 1. The total quantity of copper reported from these counties is 137,526,891 pounds.

Mining for silver is practically at a standstill; hence it is that so few lead mines were heard from.

Only 1,390,550 pounds of lead were reported, distributed according to productive mines, by counties, as follows: Cochise, 2 mines; Mohave, 2; Yuma, 2; Santa Cruz, 1.

Gold is reported, by counties and mines, as follows: Yavapai County, 24 mines; Mohave, 9; Cochise, 7; Pima, 4; Pinal, 4; Yuma, 4; Santa Cruz, 2; Maricopa, 1.

The value of the gold and silver output in Arizona for 1903, as reported by the United States Mint and by the United States Geological Survey, differs considerably as to gold and to some extent as to silver. The cause of this discrepancy may be due to the shipping of gold in the form of placer dust, amalgam, or bullion in bars, from the State of Sonora, Mexico, into the Territory. Such gold would be disposed of to the banks and eventually be shipped to the mint at Denver, Colo., or to San Francisco, Cal., by express. It is possible that this bullion is credited to the output of Arizona.

CALIFORNIA.

By Chas. G. Yale.

PRODUCTION.

Returns received by the United States Geological Survey show California to have produced in the calendar year 1903 gold to the value of $16,300,653; silver (commercial value), $498,412; copper, $2,533,355; lead, $7,074, and platinum, $952, a total of $19,340,446.

In "Mineral Resources of the United States for 1902" the chapter on the "Production of gold and silver" was prepared by Mr. George E. Roberts, Director of the Mint. For that year he credited California with a gold production of $16,792,100, and with a silver production (commercial value) of $477,424. Comparing those figures with the returns for 1903, the State shows a decrease in gold product of $491,447, and an increase in silver product of $20,988, making a total decrease of $470,459. This loss in annual product may be attributed chiefly to labor strikes at various large producing gold mines and copper mines producing gold, which caused the enforced idleness of such mines for periods of from one to three months. These troubles were not confined to any one section, but occurred in the Mother Lode counties where many of the largest producers are situated, in Kern County to the south of San Francisco, and in Shasta County to the north. The mines ultimately resumed operations, though several have had to employ nonunion men and are not working the same force as formerly, work being thus more or less hampered.

Conditions vary but slightly from year to year in California mining, much depending, however, on the winter rain and snowfall as to results of water supply for the following summer. This affects not only the gravel mines, but the quartz properties as well, the latter using the water for power, either direct or transformed to electricity. The winter of 1903–4 was an exceptionally favorable one as compared with three or four preceding ones, there having been abundance of rain and snow, giving plenty of flow in the streams in the spring. The result of this abundant water supply has more effect on the returns of bullion to come for 1904, however, than on the 1903 returns. The rainfall of the winter of 1902–3 was scant, and most of the gravel miners working their claims in the summer of 1903 had a very short water season in consequence; and in the fall of 1903, before the winter rains set in, a number of the larger quartz mills were compelled to "hang up" all or part of their stamps for a time, owing to lack of water for power. These features, in addition to the labor troubles referred to, readily account for the reduction in bullion in 1903.

The most noteworthy feature in connection with the gold production in California is the marked and rapid advance of the gold-dredging industry. In fact, the increase of gold from this source did much to make up for the deficiency in other classes of mines in 1903. The total returns from the dredgers operated in 1903 were $1,475,749, as compared with $867,665, an increase of $608,074. This result was obtained from 25 machines operating at Oroville, Butte County, 3 in Sacramento County, 1 in Siskiyou, 1 in Trinity, and 1 in Yuba. Of the total for 1903 the sum of $1,329,998 came from Butte County, the center of the dredging industry. The number of dredges in the first part of 1904 at Oroville was 27, and in the summer of that year 2 of the largest dredges in the State were installed between Marysville and Smartsville, on the Yuba River. Others have been built in Calaveras, Shasta, and Trinity counties, and more are being constructed at different points. Ground suitable for dredging purposes is being prospected in many counties of the State, and is in great demand at prices ranging from $500 to $3,000 per acre, according to prospective value.

For the first time in the history of the State the output of the dredgers has exceeded that of the hydraulic or the drift mines. This fact alone shows the rapid advance of this branch of gold mining. The hydraulic mines produced in 1903 the sum of $872,812, and the drift mines $905,679. The dredge output exceeded each of these and came within about $300,000 of equaling the product of hydraulic and drift mines combined.

The principal section of hydraulic mining has changed of late years, and is now in Trinity and Siskiyou counties, though Nevada County shows a yield from this source of $124,439. Trinity produced $233,093 and Siskiyou $173,337 from hydraulic mines. Placer County leads all others in drift mining, its output having been $331,002 from this source. Sacramento County comes next with an output of $213,867. Sierra, Butte, and Plumas counties have been eclipsed in this respect by Sacramento, where little or no drift mining was carried on until recent years. The operations in the Blue Ravine section above Folsom have brought about this result. The largest drift mining operations, however, are still carried on in Placer County.

The quartz mines, however, continue to be the main source of the California gold supply, the sum of $12,247,892 out of $16,300,653 having come from quartz in 1903. This shows that fully 75 per cent of the California gold comes from the quartz properties, the other 25 per cent being from hydraulic, drift, and surface placer mines. The largest amount of quartz came in 1903 from Nevada County, followed in relative rank by the counties of Tuolumne, Calaveras, Amador, and Kern, all of which show a yield in excess of a million dollars, Nevada County alone producing over two millions. Among these counties, Amador, Calaveras, and Tuolumne are mother lode counties; Nevada and Kern are not. Considering total output of gold from all classes of mining in 1903, the rank of the counties showing over a million dollars each is as follows: Nevada, Tuolumne, Calaveras, Butte, Amador, Kern. Of these, three are mother lode counties and three are not.

The quartz-mining industry has been fairly prosperous during 1903, but, as already stated, has been more or less hampered by labor troubles. There has been increased development in both new and old mines, and a number of old mines have been reopened and suitably equipped. Some mines developed in previous years have had machinery installed and have become producers. There is a constantly increasing tendency to enlarge the capacity of the stamp mills at the older mines, and new mills now erected are given more stamps originally than was formerly the practice. This is due to the possibility of working lower grade ore than in the past and to the recognition of the fact that such mines can be worked at a profit with extensive reduction facilities, while small mills do not bring satisfactory results. Some of the mines are yielding well at a depth of 2,500 feet, and shafts are being sunk to 2,800 feet. The experience of the few mines working at such depths has given greater confidence to those persons with smaller mines, as the ore bodies have held out well, and in some instances richer bodies have been discovered. Numbers of "prospects" are found each year and in due time become more or less developed; but, as in all mining regions, the great difficulty with the prospector is to turn these prospects into mines without the assistance of capital. The capitalists desirous of investing, want "going" mines, and prospects, until pretty well developed by their owners, are not in demand.

The following table shows the source of California gold, by counties. It is possible that values in the column headed "Surface placer," which includes ordinary placers, ground sluice mining, river bed and bar mining, ocean beach mining, etc., may be too high, as in some of the answers to inquiry the miners fail to make the distinction between surface and placer or deep, drift, or hydraulic mining, answering simply "placer." Some of the gold attributed to this source should probably be credited to the drift or hydraulic mining columns.

Sources of California gold, by counties, 1903.

County.	Gold from quartz.	Hydraulic mines.	Drift mines.	Dredging.	Surface placer.	Total gold.
Alpine	$2,726					$2,726
Amador	1,369,357	$1,300	$1,060		$12,791	1,384,508
Butte	66,614	33,176	64,064	$1,329,998	48,069	1,541,921
Calaveras	1,803,055	48,304	26,927		20,219	1,898,505
Del Norte		6,633			4,250	10,883
Eldorado	288,865	12,849	14,106		48,496	364,316
Fresno	17,809	1,800			3,140	22,749
Humboldt		37,839			3,850	41,689

Source of California gold, by counties, 1903—Continued.

County.	Gold from quartz.	Hydraulic mines.	Drift mines.	Dredging.	Surface placer.	Total gold.
Inyo	$101,104					$101,104
Kern	1,041,511				$6,750	1,048,261
Lassen	93,599					93,599
Los Angeles	3,965				2,200	6,165
Madera	66,048					66,048
Mariposa	565,303		$235		1,500	567,038
Mono	376,655				2,900	379,555
Monterey	1,699				9,720	11,419
Nevada	2,062,148	$124,439	122,570		39,876	2,349,033
Orange					150	150
Placer	123,080	67,185	331,002		170,441	691,708
Plumas	137,154	48,944	29,532		58,549	274,179
Riverside	12,653		300			12,953
Sacramento			213,867	$102,097	15,000	330,964
San Bernardino	378,294				8,880	387,174
San Diego	359,656				18,500	378,156
San Luis Obispo					1,084	1,084
Shasta	712,338	1,143	300		14,518	728,299
Sierra	133,028	51,805	80,329		42,751	307,913
Siskiyou	332,754	173,337	11,328	7,318	112,873	637,610
Trinity	290,172	233,093	3,400	10,600	76,746	614,011
Tulare	7,215					7,215
Tuolumne	1,898,308	5,000	4,053		4,189	1,911,550
Ventura	87					87
Yuba	2,695	25,965	2,606	25,736	71,079	128,081
Total	12,247,892	872,812	905,679	1,475,749	798,521	16,300,653

The returns from California received by the survey were from 512 producing quartz mines and 648 placer mines, including surface placers, hydraulic, and drift, or 1,160 producing mines in all. In addition returns were received from 1,098 quartz and 328 placer mines which were in course of development but were not productive. These active but nonproductive mines are therefore shown to number 1,426; and there are also many additional mines which are idle or on which assessment work only is done.

The following table shows the production of gold, silver, copper, lead, and platinum in California in 1903, by counties, as per returns received by the United States Geological Survey:

Production of gold, silver, copper, lead, and platinum in California in 1903, by counties.

County.	Gold.		Silver.[a]		Copper.		Lead.		Platinum.	Total.
	Placer.	Quartz.	Placer.	Deep mine.						
	Value.	Value.	Value.	Value.	Pounds.	Value.	Pounds.	Value	Value.	Value.
Alpine		$2,726		$52						$2,778
Amador	$15,151	1,369,357	$4	5,392	15,000	$1,650				1,391,554
Butte	1,475,307	66,614	259	2,467					$210	1,544,857
Calaveras	96,450	1,808,055	10	73,949	2,448,182	321,882				2,294,346
Del Norte	10,888									10,888

[a] Commercial value.

Production of gold, silver, copper, lead, and platinum, etc.—Continued.

County.	Gold.		Silver.[a]		Copper.		Lead.		Platinum.	Total.
	Placer.	Quartz.	Placer.	Deep mine.						
	Value.	*Value.*	*Value.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Value.*	*Value.*
Eldorado	$75,451	$288,865								$364,316
Fresno	4,940	17,809		$111						22,860
Humboldt	41,689								$362	42,051
Inyo		101,104		23,850	18,850	$2,500	161,188	$6,830		134,284
Kern	6,750	1,041,511		117,659	4,300	559				1,166,479
Lassen		93,599		1,307						94,906
Los Angeles	2,200	3,965								6,165
Madera		66,048		14	36,000	4,680				70,742
Mariposa	1,735	565,303		3,859	39,645	4,780				575,677
Mono	2,900	376,655		23,710	9,810	1,300	4,720	200		404,765
Monterey	9,720	1,699		15						11,434
Nevada	286,885	2,062,148	$21	5,575						2,354,629
Orange	150									150
Placer	568,628	123,080	76	760	4,000	520			280	693,344
Plumas	137,025	137,154		355	1,900	247				274,781
Riverside	300	12,653								12,953
Sacramento	330,964		171							331,135
San Bernardino	8,880	378,294		13,421	60,400	7,852	802	34		408,481
San Diego	18,500	359,656		1,462						379,618
San Luis Obispo	1,084									1,084
Shasta	15,961	712,338		214,028	16,453,409	2,171,497				3,113,824
Sierra	174,885	133,028		271	200	28				308,212
Siskiyou	304,856	332,754	38	949						638,597
Stanislaus					122,000	15,860				15,860
Trinity	323,839	290,172	41	184					100	614,336
Tulare		7,215								7,215
Tuolumne	13,242	1,898,308		8,361			236	10		1,919,921
Ventura		87								87
Yuba	125,386	2,695	41							128,122
Total	4,052,761	12,247,892	661	497,751	19,218,696	2,533,855	166,946	7,074	952	19,340,446
Grand total		16,300,653		498,412		2,533,855		7,074	952	19,340,446

[a] Commercial value.

COLORADO.

CRIPPLE CREEK.

During 1903 the production of Cripple Creek suffered a considerable reduction, due to several causes. One of the most serious was a strike which interfered greatly with the work from August to the end of the year. Another was found in the drainage. Many mines were unable to sink their shafts deeper until relieved by drainage tunnels from the heavy influx of water. Finally, the payshoots in some mines undoubtedly showed a tendency to contract.

The El Paso drainage tunnel, which was intended to unwater the western half of the district to an elevation above sea level of 8,800 feet, was completed in the last months of 1903, and this great enterprise will be rewarded by an increased production in 1904. Two of the important producers in the district, the Elkton and the Mary McKinney, have already been enabled to continue operations to the level of the tunnel. The Portland mine, which is the largest property in the district, produced 90,000 tons of ore having a gross value of $2,609,000; dividends of $360,000 were declared during the year; extensive development continued and opened a large amount of ore reserves. Stratton's Independence continued its large production, and its dividends amounted to $260,000 during the year. Other important dividend payers were the Strong, the Golden Cycle, and the Vindicator mines. Valuable ore bodies were developed in the El Paso, the C. K. & N., and many other mines, the working of which will swell the production of 1904. The extensive holdings of Stratton's estate were practically idle during the last half of the year. Dividends of less than $100,000 were declared by the Mary McKinney, the El Paso, the Last Dollar, the C. K. & N., the United Gold Mines, the Practical, the Acacia, the Free Coinage, and the Modoc mines. Several beginnings were made to utilize the low-grade oxidized ores of the camp. A cyanide mill was built on the Fluorine at Copper Mountain by the Sioux Falls Company, and another by the Homestake Company on Ironclad Hill, and both were ready to begin operations at the close of 1903. The capacity of these mills is only 200 tons per day, but if successful they will be enlarged. The profits of mining and milling these ores are expected not to exceed $5 per ton; the telluride ores, on the other hand, can hardly be utilized unless they run at least $12 per ton.

In June, 1903, the resurvey of the Cripple Creek district was begun by the United States Geological Survey, with Messrs. W. Lindgren and F. L. Ransome in charge. This examination was undertaken jointly by the Survey and the State of Colorado, citizens of Cripple Creek, Colorado Springs, and Denver having contributed to the State's share of the expense. The resurvey was completed in April, 1904, and the results will be published in an extensive monograph. A preliminary report of the principal results obtained will be published in a bulletin to be issued by the Survey in the last months of 1904.

IDAHO.

By V. C. Heikes.

PRODUCTION.

The precious-metal industry of Idaho during 1903 shows a considerably increased yield in silver, by reason of the extended mining operations in the Cœur d'Alene region, and a decrease in the yield of gold. This decrease has been due in great measure to the reduced number of miners at many of the smaller placers, where operations in the primitive manner heretofore conducted are no longer found sufficiently remunerative. Nevertheless, the quantity of gold taken from the placers has not suffered any material reduction and represents a large percentage of the precious-metal value of the State. The work already begun with improved dredging machinery and hydraulic power will no doubt greatly increase the future gold production. For each of the last two years the water season has been very short.

Throughout this chapter silver is given in figures of commercial value or amount obtained for it by producers when sold.

The following table shows the production of silver and gold for 1902 and 1903:

Production of gold and silver in Idaho in 1902 and 1903.

	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
Gold	72,182	$1,492,002	65,850	$1,361,119
Silver	6,183,025	[a] 3,225,066	7,398,970	[b] 3,951,790

[a] Silver at $0.5216, average commercial value.
[b] Silver at $0.5341, average commercial value.

From this table it appears that the decrease in the gold production in 1903 as compared with 1902 was $130,883, and that the increase in the silver production in the same period was $726,724.

The following table shows the output of gold in Idaho for the years 1902 and 1903 by counties:

Production of gold in Idaho in 1902 and 1903, by counties.

County.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
Ada, Bingham, Canyon, Elmore, and Fremont	4,047	$83,651	1,555	$32,142
Blaine	516	10,666	50	1,033
Boise	12,750	263,543	7,533	155,707
Cassia	2,244	46,383	233	4,816
Custer	3,342	69,079	5,949	122,965
Idaho	9,746	201,450	12,777	264,101
Kootenai	363	7,503	624	12,898
Latah, Nez Perces, Oneida, and Washington	722	14,924	3,267	67,529
Lemhi	6,419	132,681	8,819	182,289
Lincoln	386	7,979	79	1,633
Owyhee	25,930	535,973	19,665	406,475
Shoshone	5,717	118,170	2,880	59,530
Undistributed	....	....	2,419	50,001
Total	72,182	1,492,002	65,850	1,361,119

The table following gives the quantities of gold derived from different sources in 1902 and 1903:

Production of gold in Idaho in 1902 and 1903, by sources.

Year.	Milling ores.			Smelting ores.			
	Placer.	Siliceous ores.	Ores cyanided.	Lead ores.	Copper ores.	Total.	
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Value.*
1902	17,694	30,268	23,916	50	254	72,182	$1,492,002
1903	18,327	21,425	24,633	39	1,426	65,850	1,361,119

SUMMARY OF GOLD PRODUCED IN IDAHO IN 1903 FROM DIFFERENT SOURCES.

Gold in placer bullion.—Lemhi, Idaho, and Custer counties in the order named were the largest producers of placer gold in 1903. Shoshone County, usually one of the largest producers of placer gold, has during the last year shown a marked decline in the yield of this metal.

Gold in siliceous ores.—Idaho County, owing to its increased production of gold-carrying siliceous ores, greatly exceeds all other counties in the gold output.

Gold in ores cyanided.—Owyhee County stands first in its production of gold from ores treated by the cyanide method, with Custer and Washington counties not far behind.

Gold in lead ores.—Very little gold is obtained from the lead ores of Idaho.

Gold in copper ores.—Custer County is the only one whose copper ores carry a fair amount of gold.

The following table shows the output of silver in Idaho for the years 1902 and 1903 by counties:

Production of silver in Idaho in 1902 and 1903, by counties.

County.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
Ada, Elmore, Fremont, Nez Perces, Oneida, and Washington	4,259	$2,222	60,951	$32,554
Blaine	200,900	104,789	334,393	178,599
Boise	19,669	10,259	8,432	4,504
Cassia	75	39	4	2
Custer	232,145	121,087	130,560	69,732
Idaho	8,518	4,443	6,026	3,218
Kootenai	16,234	8,468	14,448	7,717
Lemhi	2,902	1,514	10,434	5,573
Owyhee	696,442	363,264	762,601	407,307
Shoshone	5,001,881	2,608,981	6,071,118	3,242,584
Total	6,183,025	3,225,066	7,398,970	3,951,790

The following table shows in detail the sources of silver in Idaho during 1902 and 1903:

Production of silver in Idaho in 1902 and 1903, by sources.

Year.	Milling ores.			Smelting ores.		Total.	
	Placer.	Siliceous ores.	Ores cyanided.	Lead ores.	Copper ores.		
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Value.*
1902	2,688	681,981	95,905	5,390,548	11,903	6,183,025	$3,225,066
1903	6,058	712,667	157,950	6,426,941	95,354	7,398,970	3,951,790

SUMMARY OF SILVER PRODUCED IN IDAHO IN 1903 FROM DIFFERENT SOURCES.

Silver in placer bullion.—The gold from placer and surface mines ranges from 630 to 950 fine. The silver production from this source does not materially affect the total output.

Silver in siliceous ores.—Owyhee County yields largely from milling ores, with Idaho County following.

Silver ores cyanided.—The yield in Custer County doubled in its production of silver from cyanided ores. Owyhee County remained the same as last year.

Silver in lead ores.—The Coeur d'Alene region of Shoshone County is responsible for an increase of over 1,000,000 ounces in the silver output compared with last year. Blaine County increased 100,000 ounces. Custer County decreased in its silver output.

Silver in copper ores.—The increased amount of copper ores mined caused the silver output to be doubled in Washington, Custer, and Kootenai counties.

MONTANA.

By A. N. WINCHELL.

PRODUCTION.

The most important development in precious metal mining in Montana during 1903 was the continued success and improvement in the cyanide treatment of gold ores in central Fergus County, resulting in still further increasing the gold production from that county, and, in fact, placing it in the lead among the counties of the State as a producer of the yellow metal. The Kendall, the Barnes-King, and the Gold Reef properties were in successful operation throughout the year.

Silver Bow County produces over 20 per cent of the annual gold product of the State and more than three-fourths of the silver product. The generally prosperous condition of precious-metal mining in the State is attested by the fact that in spite of two important interruptions to the mining operations in that county the total gold production of the State shows an increase, and that the total silver production suffered only a slight decrease as compared with that of the preceding year.

The first of these interruptions, which lasted about two months, affected all the properties of the Anaconda and the Washoe companies. It was caused by the closing of the Washoe smelter at Anaconda to permit of the completion and the connection of a new flue and stack erected on the hill back of the smelter. The object of this new arrangement is to render the fumes harmless by causing the injurious elements to settle in the long flue on the mountain side, and by carrying the lighter gases into the upper air currents. The second interruption affected all the properties of the Amalgamated Copper Company, and lasted from October 22 to November 11, 1903. It was an outgrowth of the mining litigation which has been carried on in Butte for years.

During the year the Pittsburg and Montana Company very nearly completed the building of a new smelter and concentrator at Butte, intended to treat custom ores as well as the gold-silver-copper ores from the mines of the company, which are located on the flat east of Anaconda hill. The same company purchased and partly developed some mines in Jefferson County, rich in iron pyrites, which it is planned to use in the smelting of the other ores.

The matte furnace building at the Butte Reduction Works in Butte, which was destroyed by fire, was immediately rebuilt in an improved condition. Improvements, more or less extensive, were also made at the concentrator of the United Copper Company at Basin, and at the plant of the American Smelting and Refining Company at East Helena.

During a few months of the year the affairs of the Granite-Bimetallic Company in Granite County were in the hands of a receiver, who was discharged near the close of the year. The company has been operating continuously since then.

NEVADA.

By Charles G. Yale.

PRODUCTION.

The returns received in answer to inquiries as to gold and silver production in Nevada for 1903, show that the gold amounted to $3,070,350, and the silver to $2,098,912 (commercial value), a total of $5,169,262. Compared with the figures of the previous year there is shown an increase in gold of $175,050, and in silver of $113,426, a total increase of $288,476. It is proper to state that the total figures of the year's gold and silver production, as here given, are nearly $950,000 less than those given in the report of the Director of the

United States Mint for the same period. Yet all the known producers of the State have answered the inquiries made by the Survey, and given the figures of production.

In obtaining the exact facts, however, there are several difficulties to overcome. A large amount of leasing is done in Nevada, and it is very hard to get at returns from these lessees. They only work during certain months of the year and then leave for parts unknown; so that letters sent them are returned "uncalled for." Many of the companies owning mines worked by lessees return but small values of production, amounting only to their royalties, and the sums obtained by the lessees is unknown. Sometimes a company returns as answer "no product," when its mine has been under lease to others, the company itself having done no work on its own account. Another great hindrance in arriving at the true production of Nevada is the fact that in a great many cases mines are either owned or controlled by Utah and Colorado people, and the production is attributed by the smelters to those States instead of to Nevada, where it originated. The small individual owners or lessees in many instances fail to make returns, the aggregate of which would make a considerable addition to the total. In view of these circumstances it is quite probable that the actual amount of gold and silver produced in Nevada in 1903 was somewhat higher than is indicated by the figures herein given. And this, notwithstanding the fact that every effort was made to ascertain the exact truth, many special letters having been written in addition to the sending out of the usual circulars and cards.

About 600 mining operators responded to the inquiries of the Survey. Of these 145 were producers and 454 were doing development or annual assessment work only, without any yield of bullion. Of the producers 132 had quartz and 13 had placer mines. Of the assessment or development claims 446 were quartz. The record of the respective counties is as follows: Churchill, 14 quartz mines being developed, with no producers; Douglas, 7 quartz and 2 placer mines, with 4 producers; Elko, 11 producing quartz mines and 2 placers, with 18 quartz mines and 1 placer in development stage; Esmeralda, 16 producers and 40 nonproducers; Eureka, 14 producers and 17 nonproducers; Humboldt, 8 quartz and 2 placer-producing mines and 48 nonproducers; Lander, 5 producing mines and 16 nonproducers; Lincoln, 12 producers and 48 mines in development stage; Lyon, 12 producers and 21 nonproducers; Nye, 9 producers and 79 nonproducers; Ormsby, 1 producer reported and 14 mines are being developed; Storey, 17 productive mines and 25 nonproductive; Washoe, 17 producers and 49 nonproducers; White Pine, 18 quartz mines and 6 placers which are productive, and 50 quartz mines and 5 placers which are not.

The largest aggregate output shown by any one county is in the case of Nye, where the Tonopah mines are situated. From this camp only the highest grade ores were shipped out for treatment, as there were no reduction works of any kind at the place. Since the period of this inquiry a railroad has been completed to the camp (July, 1904), so that all ores may now be shipped and the yield will be very greatly increased. The largest producer in the State, the Tonapah Mining Company, is in this county.

Lincoln County also shows a yield of considerably over a million dollars. The Bamberger-Delamar mines at Delamar are in this county as are also the Quartette and the Duplex mines at Searchlight. According to returns received, these two counties of Lincoln and Nye are the only ones in the State showing a yield of over a million dollars each, and the figures for the latter amount to practically two millions. The new and exceptionally rich camp of Goldfields, in Esmeralda County, since very productive, was just commencing to show some yield at the end of 1903. Quantities of very high grade ore have si nce been shipped. The gross yield of the Comstock mines is practically shown by the figures for Storey County—$453,785, of which $329,656 was gold and the remainder was silver. Including the yield of copper and lead as well as of gold and silver, the total production of Nevada for 1903, as shown by returns received by the Survey, amounted to $5,327,927, as is set forth in the following tables:

Production of precious metals in Nevada in 1903, by counties.

County.	Gold.		Silver.	Copper.	Lead.	Total.
	Placer.	Deep.				
	Value.	*Value.*	*Value.*	*Value.*	*Value.*	*Value.*
Douglas	$3,397	$1,700	$2,000	....	....	$7,097
Elko	14,025	187,826	32,843	....	$14,150	248,847
Esmeralda	....	189,631	174,530	$3,933	28,251	396,345
Eureka	....	83,051	52,609	....	16,176	151,836
Humboldt	40,000	34,231	6,562	....	....	80,793
Lander	....	38,320	130,786	391	399	169,896
Lincoln	....	1,091,595	101,692	2,255	700	1,196,242
Lyon	1,000	230,979	63,165	....	....	295,144
Nye	....	646,153	1,304,372	....	6,018	1,956,543
Ormsby	....	8,000	6,000	....	....	14,000
Storey	....	329,656	124,132	....	....	453,788
Washoe	....	45,332	21,494	....	....	66,826
White Pine	6,761	118,690	78,727	200	86,192	290,570
Total	65,186	3,005,164	2,098,912	6,779	151,886	5,327,927
Grand total	....	3,070,350	2,098,912	6,779	151,886	5,327,927

Sources of Nevada gold, 1903, by counties.

County.	Gold from quartz.	Hydraulic mines.	Surface placer.	Total gold.
Douglas	$1,700	$897	$2,500	$5,097
Elko	187,826	14,028	....	201,854
Esmeralda	189,631	....	....	189,631
Eureka	83,051	....	....	83,051
Humboldt	34,231	10,000	30,000	74,231
Lander	38,320	....	....	38,320
Lincoln	1,091,595	....	....	1,091,595
Lyon	230,979	....	1,000	231,979
Nye	646,153	....	....	646,153
Ormsby	8,000	....	....	8,000
Storey	329,656	....	....	329,656
Washoe	45,332	....	....	45,332
White Pine	118,690	....	6,761	125,451
Total	3,005,164	24,925	40,261	3,070,350

OREGON.

By Charles G. Yale.

PRODUCTION.

According to the returns received from operators in Oregon, that State produced $1,412,208 in gold and $62,241 (commercial value) in silver in 1903. With the value of copper and platinum added, the total yield was $1,477,516. When these figures are compared with those for 1902 furnished the Survey by Director Roberts of the United States Mint, the gold yield shows a decrease of $404,492 and the silver an increase of $12,792, a total decrease of $391,700. The yield was made by 302 producing mines, 72 quartz mines and 230 placer, hydraulic, and surface mines. The quartz mines produced $941,188; the hydraulic mines, $356,969; and the placers, $114,051. In addition to these the returns show 477 quartz and 57 placer mines upon which development or annual assessment work was done. The largest yield was from Baker County, followed, in relative rank, by the counties of Josephine, Grant, Jackson, Douglas, Lane, Malheur, Wheeler, Curry, Coos, Lincoln, Crook, Wallowa, and Union.

The following table shows the number of producing quartz and placer mines, and the number on which development or annual assessment work was done in 1903, in the respective counties of Oregon, as reported in the returns received by the survey:

Producing and nonproducing mines in Oregon in 1903, by kinds and by counties.

County.	Producing mines.		Development or assessment mines.	
	Quartz.	Placer.	Quartz.	Placer.
Baker	19	34	125	10
Coos	1	2	3	....
Crook	1	1	11	....

Producing and nonproducing mines in Oregon in 1903, etc.—Continued.

County.	Producing mines.		Development or assessment mines.	
	Quartz.	Placer.	Quartz.	Placer.
Curry	2	10	12	8
Douglas	7	23	40	5
Grant	12	8	69	5
Harney			5	
Jackson	12	56	56	8
Josephine	11	78	70	17
Lane	3		5	
Lincoln		1		2
Malheur	3	8	64	
Union	1		6	
Wallowa		1	11	
Wheeler		8		2
Total	72	230	477	57

This table shows that returns were received from more than 800 mines in Oregon, but practically three-fifths of these were nonproductive, being in the development stage only. The falling off in yield is due to the lowered production in 1903 of some of the large producers. The productive regions are in the Blue Mountain section in eastern Oregon, the mountainous section of the southwest, and more or less in the Cascades along their whole length in the State. The most extensive developments have been in Baker, Wallowa, Grant, and Malheur counties, in eastern Oregon. Baker County is the center of this section and the scene of the largest operations. It is the most productive county in the State.

The sources of the gold in the counties of Oregon is shown in the following statement:

Sources of Oregon gold, 1903, by counties.

County.	Gold in quartz.	Hydraulic mines.	Surface placer.	Total gold.
Baker	$609,097	$65,350	$17,099	$691,546
Coos	1,580		6,830	8,410
Crook	441		600	1,041
Curry	1,150	4,394	9,113	14,657
Douglas	19,982	16,556	5,793	42,331
Grant	85,372	12,906	4,035	102,313
Jackson	20,421	83,088	19,470	122,979
Josephine	160,006	141,948	40,179	342,133
Lane	31,125			31,125
Lincoln			8,000	8,000
Malheur	12,000	15,927	1,300	29,227
Union	14			14
Wallowa			350	350
Wheeler		16,800	1,282	18,082
Total	941,188	356,969	114,051	1,412,208

Production of gold, silver, copper, and platinum in Oregon in 1903, by counties.

County.	Gold.		Silver.		Copper.		Platinum.	Total.
	Quartz.	Placer.	Quartz.	Placer.				
	Value.	*Value.*	*Value.*	*Value.*	*Pounds.*	*Value.*	*Value.*	*Value.*
Baker	$609,097	$82,449	$12,509	$11				$704,066
Coos	1,580	6,830	10				$640	9,060
Crook	441	600	1,000					2,041
Curry	1,150	13,507					480	15,137
Douglas	19,982	22,349	685				8	43,024
Grant	85,372	16,941	34,439		4,000	$376		137,128
Jackson	20,421	102,558	11	2				122,992
Josephine	160,006	182,127	13,003	32	14,000	1,563		356,731
Lane	31,125		535					31,660
Lincoln		8,000						8,000
Malheur	12,000	17,227						29,227
Union	14		4					18
Wallowa		350						350
Wheeler		18,082						18,082
Total	941,188	471,020	62,196	45	18,000	1,939	1,128	1,477,516
Grand total	1,412,208		62,241			1,939	1,128	1,477,516

NOTE.—The department of chemistry of the University of Oregon, at Eugene, has issued a bulletin on the "Mineral Resources and Mineral Industry of Oregon for 1903," which contains full descriptions of the various districts and mines, and to which those desiring details are referred.

SOUTH DAKOTA.

By E. P. PORTER.

PRODUCTION.

During the year 1903 a vast amount of development work was accomplished in South Dakota, which, while increasing somewhat the production of precious metals for that year, should mean a greatly increased production for 1904. Several new reduction plants were completed, aggregating a capacity of 1,200 tons, and work was begun and is in course of construction on many other plants. There were more companies formed in 1902 than in 1903, but many did not start active operations until 1903. This is especially noticeable in the district around Elk Creek, Rochford, and Keystone. In addition to the formation of new companies, several of the larger companies have consolidated, which will enable them to make a total production far greater than they could have done if operating individually. Much systematic development work has been done throughout the phonolite belt, west of Deadwood, and encouraging reports come from along Deadwood and False Bottom gulches.

Successful treatment of low-grade ores by the cyanide process, increased transportation facilities, and steadily increasing mill capacity all tended to increase South Dakota production for 1903, and had it not been for the closing down of the Golden Reward smelter and a falling off in three of South Dakota's steady producers, the increase would certainly have occurred. The good results obtained in prospecting the free-milling ore veins of the Homestake system by local and Colorado companies have given an impetus to the development outside of the phonolite ore districts, and the year 1903 witnessed the transformation of many prospects into gold producers. No less than 10 companies are operating in the phonolite belt west of Deadwood, and several veins are being developed to a considerable depth. The success obtained by the Penobscot Company has stimulated mining in the Garden City district. Several deals have been consummated and several companies formed for the development of ore bodies of the same character as that found at the Penobscot. Among the companies that made their initial production in 1903 are the Columbus Consolidated, the Golden Crest, the Lexington Hill, and the Golden Empire, all in Lawrence County. Those increasing their output for 1903 were the Homestake, the Hidden Fortune, the Penobscot, the Spearfish, and the Wasp Number Two. Several new reduction plants have been completed during the year 1903, which, with their daily capacity, are as follows: The Horseshoe, 500 tons; the Hidden Fortune, 300 tons; the Penobscot, 200 tons; the Jupiter, 150 tons; the Golden Crest, 50 tons; the Extreme, 50 tons; Lundberg & Dorr, 100 tons; and the Branch Mint, 250 tons.

Other companies that have mills in course of construction or that are contemplating the erection of reduction plants are: The Reliance, 300 tons; the Columbus Consolidated, 1,000 tons; the Victoria, 300 tons; the Phœnix, 300 tons; the Deadwood Standard, 125 tons; the Dakota, 120 tons; the Minnie May, 50 tons; the Gilt Edge, 125 tons; the Lexington Hill, 300 tons; the Ruby, 100 tons; the Tinton, 300 tons; the Ohio Deadwood, 100 tons; and the Sunbeam, 100 tons.

It is less than ten years since the first cyanide plant was built in the Black Hills, and the number of plants now in operation and under construction demonstrates the success of this mode of treatment. The following mills are at present treating ore by the cyanide process: Homestake, Horseshoe, Golden Reward, Penobscot, Spearfish, Deadwood Standard, Wasp Number Two, Lexington Hill, Columbus Consolidated, Jupiter, and Imperial. The Homestake Company still leads the list of producers in South Dakota, with the Golden Reward second, and with the Horseshoe, the Spearfish, and the Penobscot running close for third. Following these come many other properties producing from $5,000 to $100,000.

Placer mining seems to be gradually dying out, and the production amounted to but a little over $10,000 in 1903, obtained mainly in Lawrence County and in the southern part of Pennington County.

A brief summary of the principal work accomplished by some of the companies in various counties follows:

Custer County.—At the Clara Belle new machinery in the way of a hoist and pump has been installed. The shaft has been sunk to a depth of 180 feet, showing some fine specimens of free-milling gold. It is the intention of the owners to continue the shaft in order to explore the ore bodies thoroughly. The Copper Butte Mining Company has been prospecting with diamond drills, and expects to start in 1904.

A new steam hoist, compressor, drills, etc., have been installed at the Cuyahoga Company's property, and plans have been made to sink to a depth of 500 feet. The Extreme Mining Company has completed its 10-stamp mill and has considerable ore on hand for concentration. The concentrates will be shipped to outside smelters.

The Gladiator Consolidated Company has been developing the Gold Fish Group, and has the main shaft down 100 feet. The company contemplates erecting a new reduction plant. The Grantz Mining Company, operating the Roosevelt Group, has sunk a shaft 280 feet, and the ore found justifies the prediction that this property will be one of the big mines of the Black Hills. A contract has been let to sink a shaft 100 feet at the Gold Standard Company. Active work was started at the Interstate Mining Company properties in January, and has continued throughout the year. A new hoisting plant was installed at the Ivanhoe, capable of attaining a depth of 500 feet. The shaft is at present 200 feet in depth and will be pushed rapidly to 400 feet. At the Minnie May a contract has been let for a new mill, steam hoist, air drills, etc. At the North Star practically no ore was treated in 1903. Active work was carried on at the Saginaw by sinking shaft and following diamond drill hole. The mine has at present reached a depth of 300 feet. Among recent organizations are the Custer Mountain Mining Company and the White Cloud Mining and Milling Company. The latter is installing complete hoisting machinery.

Lawrence County.—The mill at the Alder Creek Company's mine was active for a short time, but was closed down for several months. The ore from this mine is obtained chiefly through open cuts. At the Anaconda the shaft has been sunk to a depth of 200 feet and a crosscut has been started. A new hoisting pump has been installed at the Bear Gulch mine. At the Big Four Mining Company's mine new machinery was installed and preparations were made to sink to a depth of 500 feet. The Black Hills Belt Development Company sunk a shaft to the depth of nearly 1,000 feet, but shut down last spring, not finding any ore.

The Branch Mint Company completed their reduction plant and started work January, 1904. The Rossiter cyanide plant was running most of the year on ore from the Buxton and Bonanza mines, recently purchased by the lessees. In July the plant was shut down and the ore was treated at their 100-ton plant, located at the mine. At the Uncle Sam mine of the Clover Leaf Mining Company, extensive development work was carried on below the 700-foot level, and drifts were run to a considerable distance. The mill was in operation the entire year, although not to its full capacity.

The main shaft in the property of the Columbus Consolidated reached a depth of 500 feet. Crosscuts were driven at the 200-foot and 500-foot levels, cutting large bodies of ore. The capacity of the plant was increased to 70 tons per day, and the plant was operated for a short time during the year. New machinery was installed at the Custer Peak mine. The cyanide plant of the Dakota Mining and Milling Company was closed down most of the year for the purpose of enlarging. The mill will probably be removed from Deadwood to the mine before the capacity is increased. The mill of the Deadwood Standard ran steadily during the year, and paid its first dividend. It is stated that this company treats by cyanide cheaper than any company in the Black Hills, as ore running as low as $3 per ton has been treated at a profit. Plans are on foot to double the mill capacity. The property of the Galena S. and S. Company, embracing some 2,000 acres, has been purchased by eastern capitalists, and work is to be resumed. The Garden City group was also sold to outsiders. The Golden Crest plant was enlarged and placed in commission. The company claims to save 85 per cent of the values. The first clean-up was made in December. The Golden Reward cyanide plant was operated continuously during the year. The smelter was closed down in February, and the smelting ore was shipped to outside smelters. It is expected that the smelter will resume operations early in 1904, after the several damage suits are settled.

The Hercules Gold Mining Company has its new 4-compartment shaft down 300 feet. The ore body is widening and work is progressing. The Hidden Fortune Mining Company carried on extensive development work and completed its 300-ton cyanide plant. Some ore was shipped to Omaha smelters. A trial of the mill was made, and the mill was afterwards closed; then amalgamation plates were installed and the mill started in November.

Many improvements were made at the Homestake during the year, among which were an increase of a hundred stamps to the Amicus mill and a new 200-drill compressor.

The Horseshoe Company's plant was closed down for some time during 1903. Work was resumed in May and shipments made to the Imperial cyanide plant and to Denver, pending the completion of the 500-ton cyanide plant. This was accomplished in September, since which time the company has been operating steadily.

Considerable ore was treated at the Imperial before it closed down, the capacity of the plant was increased, and operations were resumed in January, 1904.

The Lexington Hill Gold Mining Company, a new company, made its initial production, operating an old mill on Spruce Gulch, which was included in the sale of ground to them. Nearly 100 tons a day were treated while the mill was in operation. At the Lucky Strike mine the shaft is being continued to a depth of 200 feet, following the vein from the surface. The triple-compartment shaft on the Oro Hondo was sunk 500 feet lower during 1903, and a drift was started at the 600-foot level. A new hoist was erected at the Pennsylvania and sinking was resumed. The Penobscot increased its production quite materially, operating a 125-ton cyanide plant continuously, and shipping between 50 and 100 tons per day to the smelter. At the Pluma mine development work was carried on extensively during the time that work on the new mill was stopped, pending settlement of litigation. The company is at present cross-cutting at the 300-foot and the 500-foot levels. The former cross-cut has been run 630 feet and the latter 100 feet. A considerable amount of ore has been brought down awaiting completion of the cyanide plant for treatment.

The Reliance Mining and Milling Company, a consolidation of several other large companies, started active operations, and was engaged in erecting a 300-ton plant. At the Ruby Gold Mining and Milling Company's property the new mill is about completed. The Spearfish Company operated steadily during the year, making regular clean ups. At one time during the year the company held an option on the Deadwood Standard group, but finally gave it up. A new 12-drill compressor was purchased, and preparations were made to increase the capacity of the mill. Plans were completed for erecting a new plant at the Tinton Mining Company's property. The Two Johns Company started to unwater its shaft, preparatory to resuming operations. The Wasp Number Two operated steadily during 1903, with the exception of four days. This was the longest shut down since the company started, and was caused by needed repairs. The Wasp was one of the mines that quarried the quartzite.

Among the new organizations formed in 1903 the following have carried on continuous development: The Aurizone Mining Company, Columbia Commercial Gold Mining and Milling Company, Gilt Edge Maid Mining Company, Gold Copper Mining and Development Company, Gold Eagle Mining Company, Gold Stake Mining Company, Leo Mining Company, and the United Ruby Gold Mining Company.

Among companies installing new machinery and not mentioned previously are: the Elliptic, the Rex, the Gladiator Consolidated, the Tintanic, and the Wanconda.

Pennington County.—The Black Hills and Duluth Copper Company, after prospecting the greater part of the year with a diamond drill, has purchased machinery, and will sink to a considerable depth before attempting any lateral work. A new plant will be bought to replace that of the Castle Creek Gold Mining Company, recently destroyed by fire. The new leaching plant of the Central Black Hills Copper Company was completed, but not in time to operate in 1903. The capacity is 100 tons; the process, lixiviation. After the copper has been extracted the ore will be treated by cyanide process. Work on the Cochran Mining Company, abandoned by the lessees, was resumed by the owners.

At the Columbia Gold Mining and Milling Company's properties the shaft was sunk to 200 feet and cross-cutting was commenced. At this time work was stopped, pending a settlement with the miners. A plant is contemplated. Work at the J. R. shaft of the Cumberland Mining Company was suspended for a short time during the year while a new air compressor was being installed. The shaft is now down 500 feet, and drifting has been started. Considerable work was accomplished at the Dakota and Calumet Copper Mining Company's properties. An aerial tram was erected, pumps were installed, and a small smelter was built. Drifting on the Golden Slipper was continued from the 450-foot level by the Empire State Mining Company. The Golden West 10-ton mill was operated several months, and cross-cutting was started at the 150-foot level in the main shaft on the Yellow Bird group. The company expects to enlarge mill to 100-ton capacity. Work was resumed on the Gopher property after an idleness of several years. The property is well equipped with two shafts, 110 feet and 105 feet deep, respectively.

The Holy Terror operated but a short time during the early part of the year and then suspended work on account of several damage suits. The mine was allowed to fill with water, submerging a $7,000 pump which was left in the bottom of the shaft. The Lakota Gold Mining and Reduction Company has cleaned out the Grizzly Bear mine and is erecting a 20-stamp mill and an aerial tram. Following the purchase of the Ida Florence group and the Bismarck mill, the Mainstay Mining Company inaugurated a new era of development, and has since opened a large body of good ore which is to be treated in the old Bismarck mill. The National Smelting Company started operations on ore from the Horseshoe, the Penobscot, and other mines in Lawrence County. Flux for the smelter is obtained from the Montezuma group at Deadwood.

The success of the cyanide process, operating on the black sands found in Rapid Creek, near Pactola, has been so far successful that 4 more plants are to be erected at once. The plant operated in 1903 handled about 300 cubic yards daily, and the new plants will be of the same capacity.

Work has commenced on the new shaft at the Redfern Gold Mining

Company. At the Sunbeam Mining Company's properties the shaft has attained a depth of 450 feet, and drifting has been carried on from the bottom. Enough ore has been shown to warrant a new 20-stamp mill. This mill was completed late in December. The Tycoon Mining Company has opened large bodies of ore and has decided to combine cyaniding with amalgamation. The 10-stamp mill is to be enlarged. Two new companies started operation in 1903, namely: The Burlington Mining Company and the Yellow Jacket Gold Mining Company.

Mention should be made of many other properties in South Dakota which are doing meritorious work toward making this State foremost among the gold-mining States.

UTAH.

By V. C. HEIKES.

PRODUCTION.

In the production of gold and silver, Utah's output for 1903 was much greater than for 1902, making, indeed, a very satisfactory showing, the increase being due to greater smelting facilities, better transportation rates, and the improved processes of treatment. The statement of production is as follows:

Production of gold and silver in Utah in 1902 and 1903.

	1902.		1903.		Increase (value).
	Quantity.	Value.	Quantity.	Value.	
	Fine ounces.		*Fine ounces.*		
Gold	174,547	$3,607,686	210,162	$4,344,069	$736,383
Silver	11,842,015	6,176,795	12,204,011	6,518,151	198,329

The following table shows the production of gold in Utah in 1902 and 1903, by counties:

Production of gold in Utah in 1902 and 1903, by counties.

County.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
Beaver, Iron, and Piute	23,741	$490,726	23,636	$488,556
Juab and Utah	29,909	618,219	66,009	1,364,406
Salt Lake	26,806	554,080	43,555	900,282
Summit and Wasatch	15,083	311,766	15,317	316,602
Tooele	75,326	1,556,788	56,559	1,169,075
Washington, Sevier, Grand, and Boxelder	3,682	76,107	5,086	105,148
Total	174,547	3,607,686	210,162	4,344,069

The following tables give the quantities of precious metals derived from the different kinds of ore treated:

Production of gold in Utah in 1902 and 1903, by kinds of ore.

Year.	Siliceous ores.	Ores cyanided.a	Lead ores.	Copper ores.	Total.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*
1902	5,056	98,631	33,434	37,426	174,547
1903	5,884	79,165	33,035	92,078	210,162

a Produced in Iron, Piute, and Tooele counties.

The gain in gold is accounted for by the greatly increased production of gold-bearing copper ores in Juab and Salt Lake counties, especially in the latter, owing to more extended mining operations in the West Mountain (Bingham) district, as is shown in the following tables:

Production of gold in Juab County, Utah, in 1902 and 1903, by kinds of ore.

Year.	Siliceous ores.	Lead ores.	Copper ores.a	Total.	
				Quantity.	Value.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	
1902	1,348	16,031	11,246	28,625	$591,679
1903	762	15,622	49,603	65,987	1,363,951

a The decrease is due to the closing of the Centennial Eureka mines in the Tintic district.

Production of gold in Salt Lake County, Utah, in 1902 and 1903, by kinds of ore.

Year.	Siliceous ores.	Lead ores.	Copper ores.	Total.	
				Quantity.	Value.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	
1902	22	605	26,179	26,806	$554,080
1903	4	1,076	42,475	43,555	900,282

The yield of gold from the lead ores of the Tintic district, in Juab County, and of Park City district, in Summit County, is about the same for 1903 that it was for 1902, as is shown in the following table:

Production of gold contained in lead ores in Juab and Summit counties, Utah, in 1902 and 1903.

Year.	Juab County.		Summit County.	
	Quantity.	Value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*	
1902	16,031	$331,361	15,025	$310,567
1903	15,622	322,907	14,744	304,758

Regarding the production of silver in Utah the large argentiferous lead mines at Park City continue to be great shippers and to hold their own in ore reserves, to which facts the increased mineral output of the district is chiefly owing. West Mountain (Bingham) and Tintic districts have also contributed large amounts of silver derived from the copper ores.

Utah as a producer of metals is undoubtedly showing notable development, especially in the production of copper-carrying gold and silver. The silver is derived from the following kinds of ores:

Production of silver in Utah in 1902 and 1903, by kinds of ore.

Year.	Siliceous ores.	Ores cyanided.	Lead ores.	Copper ores.	Total value.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	
1902	80,704	134,323	10,643,439	1,033,549	$6,176,795
1903	56,631	116,141	9,317,074	2,714,165	6,518,151

Production of silver in Utah in 1902 and 1903, by counties.

County.	1902.		1903.	
	Quantity.	Value.[a]	Quantity.	Value.[a]
	Fine ounces.		*Fine ounces.*	
Beaver, Iron, and Piute	247,258	$128,970	183,548	$98,033
Juab and Utah	2,813,818	1,467,658	3,622,596	1,934,818
Salt Lake	509,933	265,981	969,849	517,996
Summit and Wasatch	7,990,200	4,167,688	7,109,209	3,797,028
Tooele	264,870	138,156	263,682	140,833
Washington, Sevier, Millard, Grand, and Boxelder	15,936	8,312	55,127	29,443
Total	11,842,015	6,176,795	12,204,011	6,518,151

[a] Commercial value.

WASHINGTON.

By Charles G. Yale.

PRODUCTION.

The returns received from the State of Washington indicate an increase in gold production over that of the year 1902 amounting to $225,665, or nearly double; the silver production shows a decrease of $126,281; and the total increase for the year of the value of the combined gold and silver production is $109,384, or about 16.5 per cent, when the figures of 1902 and 1903 are compared. The gold and silver comes almost entirely from quartz mines, the total placer operations of the State, in both hydraulic and drift, only amounting in value to about $5,000, from Asotin, Kittitas, Lincoln, and Okanogan counties.

The principal increase in gold came from the counties of Chelan, Ferry, Okanogan, and Whatcom. Ferry County was the largest producer of gold as well as of silver. The rank of the counties in relative production of gold is as follows: Ferry, Chelan, Snohomish, Whatcom, Okanogan, Kittitas, Stevens, King, Asotin, and Lincoln. Their rank in silver production is: Ferry, Stevens, Snohomish, Okanogan, Whatcom, Skagit, and King. The greatest production of copper was in Snohomish County, and the most lead came from Stevens County.

A very large proportion of the known mining claims in the State of Washington are in the development stage and nonproductive. Many are held by annual assessment only. This may be seen by the following statement of the proportion of productive and development or assessment mines in the different counties, based on returns received in reply to inquiries: In Asotin County there were 1 quartz producer and 1 small placer, and 4 claims in which assessment or development work was done in 1903. There were 5 unproductive claims in Cowlitz County and 2 in Clarke County. In Chelan County 3 producers made returns and 51 mines reported as being in development or assessment stage. In Ferry County 11 quartz mines reported as having produced in 1903 and 72 reported as being in development stage. In King County only 1 producer reported, but there were 58 in the development or assessment stage. In Kittitas there were 5 productive quartz mines and 48 doing development work, and 2 productive placers and 6 in course of development. In Lincoln County there were 1 small producer and 20 other mines in process of development. In Okanogan 7 quartz mines reported as producers and 125 as in the development stage, and 5 placers, with 8 others doing assessment work. Pierce County had 1 quartz producer and 9 claims in course of development; and Skagit had 1 producer and 17 worked but unproductive mines. In Skamania County 5 claims were being developed. Snohomish County had 6 productive mines and 130 unproductive ones. Stevens had 12 productive mines and 130 in development or assessment stage. In Whatcom County there were 3 producers and 53 nonproducers.

It thus appears that out of 808 mines in Washington from which reports were received in 1903, only 60 were productive and 748 were in the development or assessment stage. This statement shows that the Washington mining industry is badly in need of the investment of capital to bring the majority of the claims to a productive stage. It shows also why there is a comparatively small annual production when the number of known mines is considered.

In the report of the Director of the United States Mint on the production of precious metals for 1902 only 25 producing mines are reported from Washington. More than double this number reported to the United States Geological Survey in 1903. This accounts for the increase shown in the product.

The following table shows the production of precious metals in Washington in 1903, by counties:

Production of precious metals in Washington in 1903, by counties.

County.	Gold.		Silver.		Copper.		Lead.		Total value.
	Deep.	Placer.	Deep.	Placer.	Pounds.	Value.	Pounds.	Value.	
Asotin	$90	$600		$6					$696
Chelan	80,090								80,090
Ferry	275,397		$83,464		75,471	$10,000			368,861
King	1,584		20						1,604
Kittitas	2,636	1,798		7					4,441
Lincoln		36							36
Okanogan	33,537	2,472	20,656		113,207	15,000	6,300	$252	71,917
Pierce	50								50
Skagit	44		865				8,400	252	1,161
Snohomish	70,661		29,876		292,863	38,720	1,200	48	139,305
Stevens	2,502		54,865		19,038	2,522	389,512	15,523	75,412
Whatcom	36,388		12,030						48,418
Total	502,979	4,906	201,776	13	500,579	66,242	405,412	16,075	791,991
Grand total	507,885		201,789			66,242		16,075	791,991

WYOMING.

By E. P. Porter.

PRODUCTION.

The mining in Wyoming in 1903 as compared with 1902 has been marked mainly by two features, the resumption of the production of copper and the amount of dead or development work accomplished. Several changes in the management of different companies have occurred, and in most cases for the better, as renewed activity has resulted and development work of a permanent character has been effected.

The mining sections of Wyoming are as a rule situated in districts far from good railroad transportation, hence it is hard to secure the capital necessary for thorough prospecting and development, but in several cases in which ore has been shown preparations are being made to build railroads.

Though copper is at present the paramount mineral included under the head of the precious metals of Wyoming, yet the gold sections are not to be overlooked.

Wyoming has heretofore produced its quota of gold, but the year 1903 fell short of former years, owing to leases being made pending sales, and to the prosecution of nothing but development work when sales were made. Again, several free-milling properties showed, with depth, changes in the character of the ore, and experiments were carried on for the proper treatment of the resulting refractory ores.

The copper production increased from practically nothing in 1902 to nearly $150,000 in 1903, and the year 1904 opened with a brighter future than ever before in the history of Wyoming. It is safe to say that within the next five years Wyoming will take high rank among the mineral-producing States of the country.

The two deepest mines in the State are the Ferris-Haggerty copper mine in Carbon County and the Carissa gold mine in Fremont County. The Ferris-Haggerty has attained a depth of some 700 feet, and has several thousand feet of drifts, crosscuts, raises, etc., showing in all cases the permanent character of the veins. Estimates made place the ore blocked out in the mine at 250,000 tons, principally copper, with slight traces of gold and silver. In addition to the underground work considerable surface work has been done; notably, one of the longest aerial trams has been built, conveying the ore 16 miles from the mine to the smelter; in addition the company has a concentrator capable of treating 300 tons a day and a smelter with a capacity of 500 tons, producing blister copper. This is hauled 40 miles to the railroad and is shipped to the east for refining.

The Carissa mine has attained a depth of 450 feet.

Albany County.—Foremost among the properties of Albany County is the New Rambler mine located on Douglas Creek, which company in 1903 shipped considerable copper ore to Denver and Chicago smelters, although at a considerable disadvantage on account of the long haul over difficult roads. One of the principal features in the ore from this mine is the platinum contained, which was successfully extracted this year from the electrolytic slimes. Development work was carried on the entire year, and shipping will be again resumed as soon as the roads become passable. The gold production in this county comes principally from placers. The largest operator, the Douglas Creek Placer Mining Company, was idle in 1903, being under bond and lease to foreign parties who contemplate erecting a large dredge capable of handling 2,000 cubic yards of gravel per day. The Acme Gold and Copper Mining Company, successors to the Wyoming Mining and Transportation Company, with a large acreage in the Gold Hill district carried on development work during the year and is prepared for an active campaign for 1904. The American Copper Company has recently installed a new steam hoist, pumps, compressor, and drills, and is engaged in sinking a 2-compartment shaft. It has prepared to go to a considerable depth to strike the vein.

Other prominent properties which are advancing regularly in development are the Wyoming Queen, the New Lincoln, the Michigan and Wyoming, the Strong, the Medicine Bow, and many others in the southern part of the county. Some work was done at Laramie Peak, in the northern part of the county, on the Three Cripples, the Tenderfoot, and the Esterbrook.

Among the new discoveries is the Antlers property, an immense body of siliceous ore which is adapted to the cyanide process. Steps are being taken toward the erection of a cyanide plant.

Big Horn County.—Active work was carried on during the year in Sunlight Basin near Cody, at Kirwin, and on Copper Mountain near Thermopolis.

The ore is principally copper, and occurs in andesite. Considerable machinery was shipped in for the purpose of the further development and determination of the ore bodies.

Carbon County.—The whole county of Carbon seems to be impregnated with mineral veins, from the line of the Union Pacific Railroad on the north to the Colorado line on the south; and though few of the properties shipped any ore in 1903, the new policy of the North American Company, which has agreed to accept custom ore, will cause many of the properties to ship in 1904.

Development work was carried on very extensively in the several camps around Encampment, Saratoga, Battle, and Rambler. Mention has been made of the Ferris-Haggerty mine, which is the foremost property in Carbon County. At the Doane-Rambler, in Battle Lake district, a new drainage tunnel has been run, and a crosscut driven from this tunnel to the main shaft. A new hoist has been installed, and sinking has been continued. There are, in addition, air compressors and machine drills. Several shipments were made from this property during the year 1903.

Upward of 50 steam hoists have been installed in this county during the year, which shows that permanent work is to be carried on.

At Pearl, Colo., on the Wyoming and Colorado line, such development work has been done that it has been deemed advisable to erect a large smelter, and preparations are rapidly advancing toward the completion of this work.

Fremont County.—For years this county has produced most of the gold in Wyoming, but in 1903 no ore was treated, although in development work the properties have been more active than for some time. The principal work was carried on by the Dexter Mining and Development Company, which is running a big operating tunnel to cut the veins of the Rose, the Tabor-Grand, and several other old-time producers. This company also owns about 600 acres of placer ground, with a very complete hydraulic plant, which was idle in 1903. The old Tabor-Grand mill was also purchased by them, and will be used for the present for test runs and the determination of treatment, until the new and larger plant can be erected.

The Wyoming Central Gold Mining and Milling Company has installed a new steam hoist, and is engaged in sinking a 2-compartment shaft. A reduction plant, capable of treating both its own and custom ores, is to be erected in the near future. At the Carissa mine, one of the oldest mines in the State, the main shaft is down 450 feet. The vein has been crosscut, showing a width of 125 feet, and a drift on the vein to a distance of 800 feet has been run. California parties have recently examined this property, with an idea of purchasing it and erecting a new reduction plant.

Laramie County.—In the Silver Crown district work has been carried on steadily, although the leaching plant, owned by the Hecla Mining and Smelting Company, treated no ore. The values in this district are mainly copper.

Much more could be written on the possibilities of mining in Wyoming, but the only attempt made here is to give a brief summary of the work accomplished and in course of completion during 1903.

COPPER.

By Charles Kirchhoff.

GENERAL TRADE CONDITIONS.

The copper-mining industry of the United States has had a prosperous year in 1903. Consumption took care of nearly the whole of the product, considerably increased as it was, and when the home markets were adversely affected by the general industrial and financial depression of the latter half of the year heavy purchases for foreign consumers, at fair prices, checked any serious decline. The good prices obtained during the spring and early summer, copper rising to 15 cents a pound, carried the average for the year fairly above 13 cents, which is moderately remunerative to the majority of producers. There has been a good deal of activity in the development of new mines, and a good deal of capital has been judiciously spent in placing many of the older mines on a sounder basis, as to equipment and as to ability to cope with increasing depth and, in many instances, with declining grade of ore. A moderate increase in the production is probable during the current year, notably in Arizona, in Utah, and on Lake Superior.

It may be doubted, however, whether consumption during 1904 will equal that of 1903, since the financial situation does not encourage the prospect of even normal activity in the development of new enterprises in electrical lines, in railroad construction, in shipbuilding, or in general manufacturing.

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, 1845–1903.

[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, 1845–1903—Continued.

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.
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
1903	311,627	85,893	27.5	121,677	38.9	65,914	21.1

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, 1893–1903.

[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	81,580,735
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, 1898–1903—Continued.

Source.	1898.	1899.	1900.	1901.	1902.	1903.
Lake Superior	158,491,703	147,400,338	145,461,498	156,289,481	170,609,228	192,400,577
Arizona	111,158,246	133,054,860	118,317,764	130,778,611	119,944,944	147,648,271
Montana	206,173,157	225,126,855	270,738,489	229,870,415	288,903,820	272,555,854
New Mexico	1,592,371	3,985,441	4,169,400	9,629,884	6,614,961	7,300,832
California	16,925,634	26,221,897	28,511,225	33,667,456	25,038,724	17,776,756
Utah	3,750,000	9,584,746	18,354,726	20,116,979	23,939,901	38,302,602
Colorado, including copper smelters[a]	16,274,561	11,643,608	7,826,949	9,801,783	8,422,080	4,158,368
Alaska	....	....	....	....	....	1,339,590
Wyoming	233,044	3,104,827	4,203,776	2,698,712	889,228	1,023,189
Nevada	437,396	556,775	407,535	593,608	164,301	150,000
Idaho	1,266,920	110,000	290,162	480,511	227,500	778,906
South Dakota	1,261,393	17,020	15,147	753,510	445,663	173,202
Washington	....	....	....	....	209,297	80,758
Maine and New Hampshire; Vermont; Tennessee and Southern States; Middle States	5,395,226	4,410,554	4,820,495	6,860,089	13,599,047	13,855,612
Lead desilverizers, etc.[b]	3,553,336	3,500,000	3,000,000	531,530	500,000	500,000
Total domestic copper	526,512,987	568,666,921	606,117,166	602,072,519	659,508,644	698,044,517
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	[c]32,000,000
Total (including copper from imported pyrites)	546,262,987	592,466,921	642,497,166	666,072,519	699,508,644	730,044,517

[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] Since 1901 the quantity stated covers only that part of the incidental copper product the source of which could not be ascertained.
[c] Estimated.

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, 1897–1903.

[Pounds.]

Mine.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Tamarack	20,222,529	19,660,480	18,565,602	19,181,605	18,000,852	15,961,528	15,286,093
Quincy	16,924,618	16,354,061	14,301,182	14,116,551	20,540,720	18,988,691	18,498,288
Osceola	11,201,103	12,682,297	11,358,049	12,567,131	13,723,487	13,416,396	16,059,636
Franklin	2,908,284	2,623,702	1,230,000	3,663,710	3,757,419	5,259,140	5,309,030
Atlantic	5,109,663	4,377,399	4,675,882	4,930,149	4,666,889	4,949,366	5,505,598
Central	611,172	291,339					
Wolverine	2,316,296	4,588,114	4,756,646	4,778,829	4,946,126	6,473,181	9,024,034
Baltic		42,766	621,336	1,735,060	2,641,432	6,285,819	10,580,997
Champion						4,165,784	10,564,147
Trimountain						5,730,807	9,237,051
Isle Royale					2,171,955	3,569,748	3,134,601
Mohawk					677,145	908,479	6,284,327
Mass			42,800	122,239	873,297	2,345,805	2,576,447

Calumet and Hecla.—The annual report of the Calumet and Hecla Mining Company for the fiscal year ending April 30, 1904, shows a production of 76,620,145 pounds of refined copper as compared with 76,632,912 pounds in the fiscal year 1902–3. The balance sheet for the last three fiscal years compares as follows:

Balance sheet of the Calumet and Hecla Company for the fiscal years ending April 30, 1902, 1903, and 1904.

	1904.	1903.	1902.
ASSETS.			
Cash, loans receivable, copper, and mineral	$6,070,918	$6,118,436	$3,950,576
Insurance fund	757,691	600,276	149,937
Bills receivable	451,521	509,584	366,658
Employees aid fund	6,208	6,583	
Total	7,286,338	7,234,879	4,467,171
LIABILITIES.			
Drafts in transit	67,682	54,397	165,636
Aid fund			17,529
Bills payable	305,617	319,284	319,651
Machinery contracts	330,000	304,174	371,575
Total	703,299	677,855	874,391
Balance	6,583,039	6,557,024	3,592,780

President Agassiz, in his annual report, states that the new openings on the conglomerate belt in the vicinity of the Red Jacket shaft have continued unsatisfactory, and that rock mined in that district shows a decrease of about 15 per cent in copper from former years. The marked cutting out of the southern extension of the copper-bearing ground has continued. Last fall the opening of the Kearsarge amygdaloid was started and three shafts have been located on the lode.

The quality of the rock encountered is fair. During 1903 five of the heads of the Calumet mill have been remodeled and the work on the six remaining heads has been started. It should be completed by May, 1905. The remodeling of the Hecla mill should be completed in the spring of 1907.

Quincy.—The Quincy Mining Company did not, in 1903, reach the product of 1902. There were mined 1,024,164 tons, of which 1,006,173 tons were hoisted, while 958,935 tons were stamped. The product was 21,159,785 pounds of mineral from the stamp mill and 4,060,435 pounds of barrel copper from the rock houses, which produced 18,498,288 pounds of refined copper, against 18,988,491 pounds in 1902. In spite of the increased quantity of rock handled, the total hoisted in 1902 having been 984,594 tons, the yield was smaller. There was realized from copper, $2,447,351.82; from interest, $11,-457.18; and from Hancock real estate account, $6,347.12. The working expenses at the mine were $1,573,863.46, the taxes in Michigan, $59,-406.10, and the cost of smelting, transportation, and other expenses, $175,184.82. The construction cost was $117,775.38, leaving as the net income $538,926.36, out of which dividends aggregating $550,000 were paid.

Tamarack.—The Tamarack Mining Company made a slightly smaller output in 1903 than in 1902, but through the opening up of ground tributary to No. 5 shaft, which is better than the average in yield, has improved its position.

In 1903 there were mined 803,262 tons, while there were stamped 657,920 tons, yielding 24,055,512 pounds of mineral, and 15,286,093 pounds of refined copper, an average of 23.2 pounds of refined copper per ton of rock stamped as compared with 24.2 pounds in 1902, when the product was 15,961,528 pounds. The cost of mining and stamping was $2.32 per ton of rock stamped in 1903 as compared with $2.30 in 1902, the cost of stamping alone being 26.24 cents and 23.30 cents, respectively. Principally through the fact that the amount expended for construction was less, the cost per pound of refined copper declined. The figures were for 1903 and 1902, respectively: Cost per pound at mine, 9.97 cents and 9.51 cents; cost of construction, 0.15 cent and 0.97 cent, and cost for smelting, freights, selling expenses, etc., 1.38 and 1.42 cents; the totals being 11.50 cents for 1903 and 11.90 cents for 1902.

The gross value of the copper at an average of 13.02 cents per pound was $1,990,045.53, to which must be added $52,177.67 for interest receipts and other income. The running expenses at the mine were $1,524,119.29, and the smelting and other expenses $210,390.72, leaving a gross profit of $307,713.19. After deducting construction expenses of $22,647.64 there was a net profit of $285,065.55, out of which a dividend of $90,000 was declared, making the total dividends since 1888, $8,580,000.

Osceola.—During 1903 the output of the Osceola company was increased over 1902. There were stamped 924,400 tons of rock, as compared with 836,400 tons in 1902, the quantity of mineral produced increasing from 18,430,012 pounds to 21,904,243 pounds, yielding respectively 13,416,396 pounds and 16,059,636 pounds of fine copper. The Osceola branch is producing from 25,000 to 30,000 tons of rock per month, containing from 16 to 17 pounds of refined copper per ton, and this it is expected can be maintained for an extended period. The principal developments of the year have been in the Kearsarge branch, the South Kearsarge having averaged a monthly shipment of rock of over 27,000 tons during the last half of 1903, an increase of over 11,000 tons per month over the best month of 1902. At the North Kearsarge branch the shipments of rock from No. 1 shaft, it is hoped, will reach a total of 20,000 tons per month, while No. 3 shaft has produced an average of 23,000 tons of rock per month. All work on the Tamarack Junior branch has been stopped.

A very considerable reduction in costs has been effected, the cost of mining and stamping per ton of rock having fallen from $1.59 in 1902 to $1.43 in 1903, while the cost of stamping has declined from 21.74 cents per ton to 17.44 cents per ton. The costs per pound of refined copper were 11.77 cents in 1902 and 10.29 cents in 1903, distributed as follows, respectively: Cost per pound at mine, 9.91 cents and 8.23 cents; construction, 0.64 cents and 0.81 cents; and smelting, freights, eastern expenses, commissions, and all other charges, 1.22 cents and 1.25 cents.

The results of the fiscal year were: Gross value of copper produced, $2,087,692.48, and balance of interest, receipts, and other income, $18,231.62. The running expenses at the mine were $1,321,193.47, and the cost of smelting, transportation, commissions, and all other charges, $201,576.59, leaving a gross profit of $583,154.04. From this must be deducted construction expenses aggregating $129,418.59, leaving as the net profit for the year $453,735.45, out of which a dividend of $96,150 was paid. Deducting from the surplus thus left of $357,585.45 the balance of liabilities at the end of the previous fiscal year of $226,025.82 leaves a balance of assets of $131,559.63. The Osceola is producing now at the rate of over 20,000,000 pounds of copper per annum.

Atlantic.—The yield of the rock of the Atlantic mine, which was 0.5547 per cent of copper in 1902, increased to 0.638 per cent in 1903. This is accounted for mainly by the smaller proportion of rock treated from "A" shaft, which was found to be very much poorer than the average. In one week's run the actual yield of mineral ran as low as 0.327 per cent. During 1903 there were stamped 431,397 tons of rock, which produced 7,670,660 pounds of mineral, or 5,505,598 pounds of refined copper, as compared with 4,949,366 pounds in 1902. The costs per ton of rock treated were: 91.91 cents for mining and surface expenses, 5.63 cents for transportation to mill, 22.39 cents for stamping and separating, 14.97 cents for smelting, freight, and marketing, a total of $1.349. Including the cost of construction, the cost per ton of rock treated was $1.384. The copper, which sold for an average of 13.12 cents, realized $722,386.47. The working expenses at the mine were $517,384.05; smelting and freight, $64,567.87, and interest on loans, $4,199.70; thus leaving a mining profit of $136,234.85. There were received $25,000 for the sale of land; and on the other hand, there were expended in construction and in exploration $10,893.19, showing a net gain for the year of $150,341.66.

Franklin.—The Franklin Mining Company produced 5,309,030 pounds of copper in 1903, as compared with 5,237,460 pounds in 1902. About 10,000 tons per month of stamp rock comes from the old Franklin mine, the remainder of the tonnage coming from the Peninsula conglomerate of the Franklin Junior. There were hoisted 349,263 tons of rock, of which 347,458 were stamped, yielding 8,132,310 pounds at the mill, and 766,077 pounds of mass and barrel work. The total receipts were $685,840.95, including $49,694.62 of cash on hand, there having been sold 4,712,388 pounds at an aggregate of $634,391.74. The running expenses at the mine were $535,811.28 and the smelting, freight, and insurance amounted to $75,640.46. The outlays for construction including the cost of installing a fourth head at the mill were $41,803.68.

Copper Range Consolidated Company.—The Copper Range Consolidated Company controls the Baltic, Champion, and Trimountain mines and the Copper Range Railroad Company, and is interested largely in the Michigan Smelting Company. During 1903 the Copper Range Company acquired 95,532 shares of stock, out of a total of 100,000 shares, of the Trimountain Mining Company through an exchange of shares. One of the terms of the agreement was that the parties owning the majority interest of the Trimountain Mining Company should pay to the Copper Range Consolidated Company a sum equal to the entire amount of the net indebtedness, which on examination of the books on September 1, 1903, showed to be about $840,000. In pursuance of this agreement there has been paid on the principal to December 31, 1903, the sum of $133,031.63. The Copper Range Company owns 50,000 shares of the Champion Copper Company, the other half being owned by the St. Mary's Mineral Land Company.

The Copper Range Consolidated Company is the second largest producer of the Lake district, there being produced during the year 1903 30,382,446 pounds of copper, which, sold at an average of 13.3453 cents, yielded $4,054,634. The mining, smelting, and marketing expenses were $2,700,647, and taxes and interest $167,931, leaving a net income of $1,186,055. Out of this dividends of $300,000 each to the Champion Copper Company and to the Trimountain Copper Company were paid, leaving $586,055. The earnings of the Copper Range Railroad Company were $116,584, and the receipts under the Trimountain agreement and other earnings carried the total to $1,015,908, from which must be deducted $133,763, being one-half the undivided profits of the Champion, which belongs to the St. Mary's Mineral Land Company, leaving as the balance of net income for 1903 $882,145.

The Baltic mine which began production on a moderate scale in 1899 reached nearly full output in 1903, with an equipment of four Nordberg stamps. There were stamped 490,237 tons of rock, which yielded an average of 21.58 pounds of copper per ton, as compared with an average of 22.842 pounds in 1902. The total production was 10,580,997 pounds in 1903, as compared with 6,285,819 pounds in 1902. The average selling price being 13.431 cents, the receipts were $1,421,211. Since the mining and smelting expenses were $897,562, and taxes and interest were $42,202, the net profit was $481,447. The improvement and construction expenses amounted to $83,818, which left a surplus of $397,629. A previous deficit was $216,831, so that the year ended with a surplus of $180,798.

The Champion mine increased its production from 4,165,784 pounds in 1902 to 10,564,147 pounds in 1903, and since its new 4-stamp mill was not in full operation during the whole of the year, it is likely to make an even larger output in 1904. The company stamped 389,082 tons of rock, which yielded 14,710,245 pounds of mineral, the yield in fine copper having been 27.15 pounds per ton of rock. The copper sold at an average of 13.37 cents, the gross receipts being $1,412,711, while the expenses at the mine were $646,959; the smelting, freight, and selling expenses were $156,745, taxes and interest were $41,480, and construction cost $274,669, leaving a surplus of $292,858, dividends aggregating $300,000 being paid.

The Trimountain, which lies between the Baltic on the north and the Champion on the south, also increased its production from 5,732,160 pounds in 1902 to 9,237,051 pounds in 1903. Since the full capacity of the 4-stamp mill was not available during the whole of the year, a further moderate increase is expected. The Trimountain stamped 507,377 tons of rock, which produced 11,558,048 pounds of mineral and 9,237,051 pounds of fine copper, the average contents of the rock crushed being 18.20 pounds per ton, as compared with 27.55 pounds in 1902. The receipts, copper having averaged 13.428 cents, were $1,077,364, and the value of the copper on hand was $143,347, a total of $1,220,711. The expenses at the mine were $867,103; smelting, freight, and commissions $132,277, taxes and interest $82,788, and construction $274,913, leaving a deficit of $136,370. Dividends of

$300,000 were paid, which increased the deficit to $436,370, which, added to a previous deficit of $291,063, made the total deficit at the end of the fiscal year $727,433.

Wolverine.—During the fiscal year ending June 30, 1904, the Wolverine Copper Mining Company hoisted 328,412 tons of rock and stamped 314,091 tons. The production of mineral was 12,152,590 pounds, which yielded 9,300,695 pounds of copper. This was sold at an average of 12.75 cents per pound, the total receipts, including $6,680 for interest, being $1,192,425. The total expenses were $600,688, leaving a mining profit of $591,737. The outlays for construction were $34,496, so that the net profit was $557,241. Dividends to the amount of $390,000 were paid.

Mohawk.—The Mohawk, which is working on the Kearsarge lode, began regular work in January, 1903, with two stamps, but the third stamp, owing to delays, did not go into commission until February, 1904. When, in addition, the 60-drill compressor is in operation the capacity of the mill is expected to be increased by 50 per cent. Ultimately, therefore, a production of about 9,000,000 pounds of copper is indicated. In 1903 the company hoisted 346,365 tons of rock and stamped 288,441 tons, which yielded 8,825,500 pounds of mineral, or 6,284,327 pounds of fine copper, an average of 21.79 pounds per ton. The cost per ton of rock hoisted was $1.37 and per ton of rock stamped $1.65. The cost of copper per pound at the mine was 7.55 cents, and the cost of smelting and freight was 1.23 cents, making the total 8.78 cents. Including the outlays for construction the cost per pound of copper was 11.02 cents.

The total receipts were $839,631, including $823,940 for the sale of 6,284,327 pounds of copper, at an average of 13.11 cents. The expenses at the mine were $474,503; for smelting and freight, $69,680; for general expenses, $7,965, and for construction, $218,075, leaving a surplus of $69,408. There were received from assessments $202,825, and taking into account a previous deficit of $18,766, there was a surplus at the end of the year of $253,467.

Isle Royale.—For the first six months of 1903 the Isle Royale Copper Company had in operation only one head of stamps, the rock being obtained from territory tributary to No. 2 shaft. In July, it was decided to reopen No. 1 shaft and start a second head, which carried the shipments to about 22,000 tons of rock per month. In December, however, shaft No. 1 was destroyed by fire, and the mine was thrown back on the operation of shaft No. 2. During 1903 there were stamped 199,493 tons of rock out of 232,851 tons hoisted, as compared with 263,672 tons stamped in 1902. The production of mineral in 1903 was 4,408,615 pounds, as compared with 5,219,305 pounds in 1902, the production of fine copper being, respectively, 3,134,601 pounds and 3,569,948 pounds. The costs compare as follows for 1903 and 1902:

At mine, 9.81 cents and 11.23 cents, respectively; construction and exploration, 0.23 cent and 0.53 cent; smelting, freight, etc., 1.81 cents and 1.69 cents; the totals being 11.85 cents in 1903 and 13.45 cents in 1902 per pound of refined copper.

The total income was $444,594.52, of which $441,313.56 was for copper sold at an average of 13.12 cents per pound. The running expenses at the mine were $307,437.32; the smelting, freights, and selling expenses were $56,617.61, and the exploration expenses, $7,258.79, leaving a net profit of $73,280.80.

Mass.—The Mass Mining Company produced in 1903 2,576,447 pounds of fine copper. The receipts from copper, assessments, etc., aggregated $345,813, while the expenditures were $434,225.

Winona.—The Winona Copper Company is still engaged in a systematic development of the mine, which is operating on the Winona amygdaloid, using one head of the Atlantic mill for stamping. During the year 1903 there were crushed 51,434 tons of rock, from which there was produced 1,687,331 pounds of mineral, yielding 1,036,944 pounds of refined copper, or 20.16 pounds per ton stamped. The receipts for copper at the rate of 13.489 cents per pound, assessments which yielded $105,124, and interest $2,254, aggregated $247,252, while the expenses were $192,858.

Adventure.—The Adventure mine, which produced 2,182,608 pounds of refined copper in 1903, received from sales $301,134. The mining expenses were $337,413; the smelting, freights, etc., $29,949; taxes, $14,051, and construction account, $61,611, leaving a deficit of $141,890.

Michigan.—An effort is being made to determine whether the Michigan Copper Mining Company possesses a paying mine. A good deal of ground has been opened, arrangements have been perfected to extend the tracks of the Mineral Range Railroad to the mine, and to transport the rock to Keweenaw Bay where the use has been obtained from the Mass Company of one head capable of crushing 500 tons of rock per day of twenty-four hours. Shipments of rock began in November at the rate of 250 tons per day, which were doubled in the spring of 1904. The mine produces a considerable quantity of mass copper, and the stamp rock has yielded an average of 13.8 pounds of ingot copper.

Ahmeek.—The Ahmeek Mining Company will appear for the first time this year as a moderate producer of copper. The company is opening up the Kearsarge lode, on the old Seneca property, and adjoins the Mohawk. The company has secured one head at the Tamarack mill, where the rock broken in development work will be stamped.

Centennial.—The Centennial Mining Company, which has concentrated its efforts on the development of the Kearsarge lode on its property, has leased two stamps of the Arcadian mill, which will be capable of handling 1,000 tons of rock per day.

MONTANA.

The copper production of Montana was hampered during 1903 by the continuance of the litigation in Butte, which has held back this great district for some years. With the exception of the product of the Indian Queen mine, and of some copper produced by the American Smelting and Refining Company and the National Smelting Company, of Rapid City, S. Dak., the total product of Montana is from the Butte district. The Amalgamated Copper Company controls the Anaconda, Colorado, Parrot, Butte and Boston, Boston and Montana, and Washoe properties, the ores of the Anaconda, Colorado, and Parrot companies being reduced at the Washoe smelter. The Butte Reduction Works treat the ores from the mines owned by Senator W. A. Clark, and the United Copper Company smelts the ores of the Minnie Healey, Corra-Rock Island, and Rarus mines. The Pittsburg and Montana Mining Company has been developing its mines during 1903 and has been erecting a smelting plant. The Speculator mine ships its ores to the smelters of the district. None of the companies of the district publish annual reports, so that statistics relating to the yield of the ores, to costs, or to financial results are not available. Statements are annually filed with the tax commissioner of Montana, which cover a fiscal year, but since they do not embrace figures as to the output of copper, silver, and gold, they permit only of approximations as to the capacity of the district to meet the world's competition in the copper market.

ARIZONA.

Arizona has resumed its growth, checked in 1902 by the falling off in the output of a few of its leading mines through temporary causes. With the newer mines, like the Calumet and Arizona, and the Shannon, reaching their full production in 1904, and with the enlarged operations of a few of its older producers, a further increase is very probable.

The Warren district, of which Bisbee is the center, and which has been famous for the old Copper Queen mine, has been the scene of an extraordinary activity in mining development. Conspicuous among the properties which have already developed large ore bodies are the Calumet and Pittsburg Company, which lies to the east of the Calumet and Arizona and is separated from it by the Lowell mine of the Copper Queen, and the Lake Superior and Pittsburg, which lies south and southeast of the Calumet and Arizona and joins both the Lowell and the Calumet and Pittsburg properties.

During 1904 there will be completed the new Douglas smelting plant of the Copper Queen Company, whose supply of ore will be drawn not only from the Copper Queen itself but also from the mines controlled by Phelps, Dodge & Company, the Moctezuma and the

Sierra de Cobre in Socorro, the Globe, and others. The plant will also be used as custom works for the smelting of copper ores and dry gold and silver ores. The works have 5 smelting furnaces of 2,000 tons aggregate daily capacity, one furnace being in reserve.

The Calumet and Arizona Mining Company has rushed into prominence as a copper producer in 1903. Having produced in 1902 only a little over 2,000,000 pounds, the company made 10,272,427 pounds during the first six months of 1903, and 15,263,430 pounds during the second half of the year. During 1903 the company mined 150,070 tons of ore, shipped 148,584 tons, and smelted 145,916 tons, from which there was recovered an average of 8.88 per cent of copper. The value of the gold and silver in the metal was $144,862.39, or an average per ton of refined copper of $11.35. During the year the highest price obtained for copper was 14.48 cents, and the lowest 11.50 cents, the average for the refined copper sold being 13.088 cents, or, deducting refining charges and commissions, 12.013 cents, and less freight, insurance, assaying, sampling, and weighing 11.558 cents. The smelting works are now treating an average of 600 tons per day of 24 hours, which, with a small outlay, can be brought up to 900 tons per day, equal to a capacity of 35,000,000 pounds per annum.

The United Verde Company produced somewhat more copper in 1903 than it did in 1902, although it has not yet returned to the normal output of former years. During 1903 the smelting plant was remodeled and enlarged, so that the production may be considerably increased.

In the Verde district a new producer of importance will appear in 1904 in the Equator Mining and Smelting Company, in which Senator W. A. Clark is largely interested. The property consists of the Iron King mine and a smelting plant with 250 tons weekly capacity. Considerable quantities of ore were in the roast yards at the close of 1903.

The George A. Treadwell Mining Company did not produce any copper worth mentioning during the trial runs of its smelter in 1903, but is expected to become a steady producer during 1904.

The Imperial Copper Company does not expect to begin production until the middle of the current year.

In the Clifton district progress is being made. The operations of the largest producer, the Arizona Copper Company (Limited), are indicated by the latest report for the six months ending March 31, 1904. At the mines electric haulage has been introduced with success. In the concentrating plants there were treated during the six months 231,552 tons of ores, which yielded 35,093 tons of concentrates. The leading plant treated 43,049 tons of tailings and produced 1,488,246 pounds of copper, the acid plant making 1,826 tons of sulphuric acid. In the smelter 49,645 tons of copper ore and concentrates and 1,491,441 pounds of copper from the leaching works were smelted, which produced 14,756,742 pounds of copper. The mine profits were £119,379, after deducting general expenses and taxes. The net earnings of the Arizona and New Mexico Railroad, owned by the company, were £39,842, making a total of £159,221. There were paid £10,505 for interest, £12,265 for dividends on preferred stock, and £107,659 on the share capital.

The Detroit Company did not produce quite as much copper in 1903 as it did in 1902, the figures being 18,917,158 pounds in 1902 and 16,558,232 pounds in 1903. No enlargement is contemplated at the present time.

The Shannon Copper Company, which first entered the ranks of producers in 1902 with a product of about 2,340,000 pounds, increased its output to 6,588,720 pounds in 1903, and in 1904 will probably exceed 12,000,000 pounds, a second section of the concentrating plant having been completed during the current year. The company has closed a contract for treating the ores of the Standard Consolidated Copper Company, of the Clifton district. The latter company is an amalgamation of the Coronado Mining Company, which has been a producer of ore on a moderate scale; the Standard copper mines, which have marketed some high grade ore, and the San Jose mines, now in course of development.

In the Globe district the most interesting event has been the amalgamation of the Old Dominion and the United Globe properties, followed by comprehensive improvements which will lead to a greatly increased output. The Old Diminion Copper Mining and Smelting Company has been an active producer for many years, but its operations were based on the smelting of its oxidized ores, with the object of making black copper in one fusion. Metallurgically, much better results can be obtained by smelting to a matte and Bessemerizing the latter. The United Globe mines in the same district can advantageously furnish sulphur ores, the siliceous ores of the property going to the Douglas smelter, owned by the same interest. As soon as the amalgamation had taken place suitable ores from the Copper Queen mines had been shipped to the Old Dominion smelter and delivered at a cost varying from $1 to $3 per ton after taking into account the values of the copper contained, an arrangement which will cease when the company begins concentrating its own sulphides. Under the new management a new well-equipped shaft has been sunk on the Old Dominion, and a new smelter is being built, with three furnaces, 44 inches by 180 inches, at the tuyeres. The matte is to be Bessemerized in a 2-stand plant. There is also being built a concentrator, with a capacity of 250 to 300 tons per day, which will be completed in 1904. In the meantime the company, which produced 7,479,721 pounds of copper in 1903, has reached during the spring of 1904 a production of

1,300,000 to 1,500,000 pounds per month by operating the old smelter, with two furnaces. It is estimated that with the new equipment a considerably larger output, approximately 2,000,000 pounds per month, will be maintained.

UTAH.

Utah has been the scene of great activity, the problem of treating the lead ores of the Bingham district in particular having been fully solved. Since 1900, when this development began seriously, the production has more than doubled, and a further increase is assured.

The Utah Consolidated Mining Company, which has succeeded the Highland Boy Gold Mining Company, an English company, is the largest copper producer in Utah. During the year 1903 there were mined 183,899 tons of sulphide ore, 6,276 tons of oxidized ore, and 81 tons of lead ore, a total of 190,256 tons, of which 6,390 tons were sold. The smelter at Murray treated 176,125 tons of sulphide ore and 6,015 tons of oxidized ore, an average of 482.5 tons per day of sulphide ore. The product was 13,023,633 pounds of bullion, which, when refined yielded 12,715,693 pounds of fine copper, 198,811 ounces of silver, and 20,028 ounces of gold, as compared with 11,840,431 pounds of copper, 160,915 ounces of silver, and 19,078 ounces of gold in 1902. The company is increasing the capacity of the smelter by 40 per cent, so that it will enter the second half of 1904 with a productive capacity of 18,000,000 pounds per annum. The company received from sales of copper, silver, and gold, $2,028,934, and expended for mining $338,524; for exportation and mine development, $6,263; for smelting and ore transportation, $515,202; and for refining charges, freight, and selling, $235,246. Taking into account miscellaneous and other outlays and a reduction in the stock of bullion on hand and of copper in process, there remained a profit of $1,038,637.

The United States Mining Company works the Telegraph, Old Jordan, and Commercial mines at Bingham, and the Centennial, Eureka, and Tintic mines in the Tintic district, and has a smelting plant of four furnaces to which a fifth has been added, with a sixth to follow. In 1903 the company produced about 8,500,000 pounds of copper, so that the output is likely to be considerably increased during the current year. The company has also begun the building of a lead-smelting plant.

The Bingham Mining Company, which operates mines both in the Tintic and in the Bingham district, has considerably increased its operations during 1903 and early in 1904. The company has issued $1,000,000 of convertible 6 per cent bonds to pay for properties acquired, and to take up $300,000 of debenture bonds. The company has a smelting plant of four furnaces, which handled in 1903 at the rate of 13,500 tons, and with a fifth stack early in 1904 were smelting 20,000 tons per month, of which about 45 per cent was custom ore. The company has entered into contracts for the smelting of the copper concentrates of the Utah Copper Company for seven and one-half years. It is estimated that a production of about 14,000,000 pounds per annum will be attained.

The Tintic Mining and Development Company, in the neighborhood of the Highland Boy and Boston properties has been developing its Yampa mines, and during the year completed a smelting plant with a capacity of 250 tons per day, which it is estimated will produce from 6,000,000 to 7,000,000 pounds of fine copper in the form of matte.

The Utah Copper Company has been developing a large body of low-grade ore in the Bingham district and is completing a concentrating plant of 500 tons daily capacity. If the results are satisfactory, a very much larger plant is to be built.

Similar ore is being treated by the Ohio Copper Company, which has acquired the Columbia mine.

The Boston Consolidated Copper and Gold Mining Company, Limited, is a Bingham property which is shipping ore to the Bingham company's smelter under a 2-year contract, which provides that there be furnished 200 tons per day of ore carrying not less than 3 per cent of copper.

There is being developed on a very comprehensive scale the Cactus group of mines at Newhouse, near Frisco, in Beaver County, by the Newhouse Mines and Smelters, an undertaking carried out by Mr. Samuel Newhouse. The Frisco branch of the San Pedro, Los Angeles and Salt Lake Railroad is being extended to Newhouse, and contracts have been let for the first 800-ton unit of a concentrating plant, the property including the Wah-Wah springs, from which the water has been piped and which will furnish a supply for a very large plant. The ore is pyritic, easily concentrated, and contains about 5 per cent. in copper, and some silver and gold. A contract has been closed with the American Smelting and Refining Company for smelting the product for a series of years.

The Majestic Mining and Smelting Company, which operates mines in the vicinity of Milford, built a smelter at Lewisville which produced a small quantity of matte during a trial run. The company has been in financial difficulties, and the plant is now idle.

A little more than 1,500,000 pounds of copper was made in 1903 by the Utah and Eastern Copper Company, with mines and smelting works in Washington County. It is expected that a larger production will be attained during 1904.

As a smelter of custom ores the Utah plant of the American Smelting and Refining Company is an important factor in the utilization of its copper resources.

CALIFORNIA.

Owing chiefly to the decline in the production of the Mountain Copper Company the output of copper from California has shown a further decline. Because of a fire and labor troubles, the Mountain Company made only 13,189,714 pounds of copper as compared with 19,500,000 in 1902. During 1903 the Keswick smelting works smelted 124,678 tons of ore, 118,973 tons being mined in that year. The Bully Hill Company, also in Shasta County, yielded a little over 2,300,000 pounds. The Balaklala in the same district is developing its mines and is about to build a smelting plant. The Trinity has not yet made plans for work on a large scale. The Great Western Gold Company, another Shasta County property, has completed a smelting works. The Fresno Copper Company is an English Company which has just ordered a large smelting and bessemerizing plant. At Campo Seco the Penn Mining Company has been producing matte in 1903 containing 2,210,000 pounds of copper. Besides this only small quantities of cement copper have been marketed by several of the old mines.

TENNESSEE AND THE SOUTH.

The Tennessee Copper Company is forging ahead, having in 1903 produced 10,690,389 pounds of fine copper, as compared with 8,103,534 pounds in 1902. A third furnace and a new blowing engine were in course of construction, which according to the estimate of Mr. J. Parke Channing, the president, will carry the output to about 14,000,000 pounds. It has been determined to increase the smelting capacity from 300,000 tons per annum to 600,000 tons by enlarging the smelter from three to six furnaces. The production of ore could be made by operating the mines double shift. The new construction will extend over eighteen months, so that the enlarged output will not come into play until well into 1905. The company is carrying out the plan of smelting unroasted or green ore, which will not only reduce the operating costs but will increase the extraction, and will make a net saving of not less than 1 cent per pound on the copper.

Mr. Randolph Adams, the general manager, in his annual report, states that there were raised and shipped from the Polk County mine 75,153 tons, from the Burra Burra 120,046 tons, and from the London 92,266 tons, a total of 287,465 tons, the ore reserves standing at the end of the year at 2,775,000 tons, an increase of 725,000 tons during the year. The charge smelted during the year consisted of 248,067 tons of roasted ore, the equivalent of 275,630 tons of green ore; 8,359 tons of siliceous ore, 213 tons of green ore, 25,336 tons of converter slag, 2,282 tons of blast-furnace by-products, 27,232 tons of quartz flux, and 5,977 tons of matte resmelted—a total of 317,466 tons, which required the consumption of 39,606 tons of coke. The production amounted to 1,922,772 pounds of fine copper in Bessemer pig, 8,736,117 pounds of refined copper, and 31,500 pounds suspended in refining, the yield calculated on the green ore being 37,615 pounds per ton of ore.

The detailed operating costs, free on board Tennessee, are as follows:

Operating costs of Tennessee copper ore, free on board.

Item.	Cost.	
	Per ton of ore.	Per pound of copper.
		Cents.
Mine development	$0.1343	0.36
Mining, hoisting, etc	.6696	1.78
Crushing and sorting	.0761	.20
Railway	.1454	.38
Roasting	.3300	.88
Credit to ore in process in roast yards	.0442	.12
Blast furnace	1.1437	3.04
Engineering and laboratory	.0324	.09
General	.1443	.38
Converting	.2692	.72
Cost of fine copper in pig	2.9892	7.95
Refining	.0971	.25
Cost of fine copper as ingot	3.0863	8.20

The treasurer, Mr. J. H. Susmann, reports that sales were made of 3,023,544 pounds of pig copper, at an average selling price of 12.17 cents, the approximate cost being 7.95 cents at works, 0.66 cent for freights, insurance, and selling expenses, and 0.30 cent for taxes, legal, and administrative expenses, a total of 8.91 cents. The sales of refined copper were 9,655,545 pounds, at an average price of 12.98 cents, the approximate costs being 8.20 cents at works and 0.96 cent as above for other costs, a total of 9.16 cents. There were inventoried at the beginning of the year 2,450,077 pounds of copper, and at the end the stock at works and on dock was 912,354 pounds.

The profit and loss account shows profits aggregating $500,419.52, which includes $74,326.57 for royalties on iron ore mined, tolls on converting outside copper matte, and on merchandise, while the expenditures include $7,500 to bond-issue account, $25,000 interest on $500,000 bonds, and $50,354.52 for depreciation. The sum of $61,785.74 was expended on construction. Two dividends aggregating $437,500 were paid. The capital stock is $5,000,000, of which $625,000 is in the treasury.

The second producer in Tennessee is the Ducktown Sulphur, Copper and Iron Company (Limited), with a production of about 3,000,000 pounds. Mr. W. H. Freeland, the general manager, reports that prior to August, 1902, the company roasted all its ore in open heaps before smelting. As the result of successful experiments in the smelting of green ore, roasting was abolished and the mines were shut down until the large stock of ore in the roast yards was exhausted in September, 1903, when mining operations were resumed. Since then the ore has been smelted without preliminary roasting. The practice consists of two operations, viz, the smelting of the green ore to a low-grade matte, carrying in the neighborhood of 20 per cent of copper, followed by a second smelting or concentration of the first product to a 50 per cent matte. In the first operation 3 per cent of coke is at present used in the charge, but it is expected that even this small amount will be dispensed with in the future. The second operation consumes a quantity of coke equivalent to 1 per cent of the original ore. Early in the current year a daily tonnage of over 400 tons of ore was being treated in this manner, which indicates an annual output of about 4,500,000 pounds of copper.

ALASKA.

Through shipments of ore to Pacific coast smelters, and to the Tacoma Smelting Company in particular, Alaska has for the first time entered the ranks of producers with the prospect that important additions to the output will be made during the current year, when several local smelting plants will render more extensive operations possible. The greatest progress has been made with the opening up of the deposits on Prince of Wales Island. The Alaska Copper Company, of Coppermount, shipped some rich ore in 1903 and is building a smelting plant. A 400-ton plant is under erection also for the Brown-Alaska Copper Company.

WYOMING.

There has been only a moderate amount of copper produced in Wyoming, the bulk of it coming from the Encampment district, in southern Wyoming. The principal interest is the North American Copper Company, which owns the Ferris-Haggerty mine and the 16-mile aerial tramway from that mine to the Encampment smelter. A good deal of underground work has been done, and the smelter has been enlarged to a capacity of 500 tons per day and a converting plant has been added, so that the current year will witness a considerable increase in the output. A considerable number of other mines in the district are being developed. The Rambler Mining and Smelting Company has shipped a small quantity of matte, but was closed down at the end of the year.

IDAHO.

A small quantity of copper was produced during 1903, during a brief period of operation of the smelting plant of the White Knob Copper Company at Mackay. The company will probably produce more regularly in 1904. At Mineral City the Ladd Metals Company has erected a furnace and has shipped some matte. Small quantities of Idaho ores reach some of the larger smelting works.

CANADA.

According to official returns, the production of Canada amounted in 1903 to 43,281,158 pounds of copper, valued at $5,728,261. The statistics of the Minister of Mines of British Columbia show a production in 1903 of 34,359,921 pounds as compared with 29,636,057 pounds in 1902. The Bureau of Mines of Ontario reports a production, during 1903, of 10,662,000 pounds, the greater part thereof being obtained as an incidental product in working the Sudbury nickel deposits.

The most important copper-producing section in British Columbia is the Boundary district, which produced, approximately, 625,000 tons of ore in 1903, the greater part of which was smelted in the local plants of the Granby Consolidated Mining, Smelting, and Power Company at Grand Forks, the British Columbia Copper Company, and the Montreal and Boston Company. All of them work large bodies of low grade ores, carrying some silver and gold. The largest of them is the Granby Company, which increased its smelting plant in 1903 to 6 furnaces with a capacity of 2,100 tons of ore per day, and is now working on the plans for an addition of 8 furnaces, which will bring the capacity up to 4,800 tons per day. The company has completed a Bessemer plant and has introduced the use of the steam shovel in its mining operations. It is estimated that when the proposed enlargements are completed the plant will produce 4,000,000 pounds per month.

The Montreal and Boston Copper Company has been consolidated with the Dominion Copper Company, the Morrison Mines (Limited), the Athalstan or Jackpot Gold Mining Company, and a three-quarters interest in the Emma mine, the new company being known as the Montreal and Boston Consolidated Mining and Smelting Company. The company proposes to increase the smelting capacity to about 1,200 tons per day, and to add a converter plant. The last annual report of the Montreal and Boston Company for 1903 shows that there were smelted during the year 112,246 tons of ore, producing 2,551,142 pounds of copper, 7,705 ounces of gold, and 58,725 ounces of silver, for which there was received, in the form of matte, $403,602. The smelting plant ran only intermittently, owing to shortage of coke during the spring and early summer. The cost, including purchases of ore, were $453,882.

The British Columbia Copper Company, which controls the Motherlode mine, produced close upon 4,000,000 pounds of copper, 50,000 ounces of silver, and 13,500 ounces of gold during 1903. The smelting plant is to be enlarged, and a converting plant is to be added. The works are to be operated by electricity from the power plant of the Cascade Water Power and Light Company, at Cascade, on the Kettle River.

The Rossland district has increased its product, the shipments having been about 377,000 tons of ore. The greater part of this ore is treated at the Le Roi smelting works at Northport, Washington, while the Trail smelters handle the bulk of the remainder. The siliceous ores of the district are being successfully concentrated in mills built and building which employ the Elmore process. The Velvet Mine (Limited) is erecting a pyritic smelter.

As indicating the character of the ores, it may be noted that the Le Roi Mining Company mined and shipped to the Northport smelter 155,765 tons of dry ore, which carried 1.526 per cent of copper, 0.709 ounce silver, and 0.373 ounce gold.

In the coast district development has been favored by the operation of the Crofton smelter of the Northwestern Smelting and Refining Company, at Crofton, Vancouver Island, and of the Tyee Copper Company (Limited) at Ladysmith. The annual report of the latter company for the fiscal year ending April 30, 1904, shows that there were mined 48,624 tons of ore at a cost of $2.21 per ton. The smelting plant handled, besides, 7,126 tons of custom ore, and 1,176 tons of ore from stock. There were produced 5,554 tons of matte, containing 4,446,987 pounds of fine copper, 143,303 ounces of silver, and 8,778 ounces of gold, the total value, less refining charges, being $678,837. The ore yielded 3.96 per cent of copper, 2.55 ounces of silver, and 0.156 ounce gold. The total receipts were £128,632, and the expenses were £103,-242, including £45,954 for mine expenses and £39,886 for smelter expenses. The profits for the year were £25,390 on a capital of £180,000.

MEXICO.

The oldest of the larger copper enterprises in Mexico is the Boleo Company, operating in the Santa Rosalia district in Lower California. It is known as a Rothschild enterprise, and its stock is held in France. During 1903 the company mined 230,490 tons of ore, which yielded 10,480 metric tons of copper, the average yield being 4.56 per cent. The net profits were 5,829,449 francs, of which 2,500,008 francs were paid out in dividends to stockholders, and 460,002 francs were paid on founders' shares.

The Boleo Company is interested in the Inguaran Company, another Mexican copper enterprise under Rothschild management. It is a low-grade proposition in the State of Michoacan, which has been prospected for a number of years, and which it is now proposed to develop fully.

The Greene Consolidated Copper Company, of Cananea, has continued its exceedingly rapid development, having produced during the calendar year 1903 about 45,000,000 pounds of copper. During the year 1904, however, the company has been producing at a rate of over 5,000,000 pounds per month, and there has been a further development of its capacity. An eighth furnace has been completed, a sixth stand of converters has been installed, and a very large new concentrating plant has been added.

The Moctezuma Company, at Nacosari, Sonora, produced in 1903 about 8,900,000 pounds of copper. Its ore will, upon the completion of the Douglas smelter, go to that plant for reduction.

In southern Mexico the most important producer is the Teziutlan Copper Company, in the State of Puebla. The plant consists of two Herreshoff furnaces, the matte being bessemerized. The production is about 400 tons of copper monthly.

CUBA.

The famous old El Cobre mines near Santiago are being developed by an American company, which has been unwatering the old workings and is now building a smelting plant at Punta Sal, on Santiago Harbor, 9 miles from the mines.

GERMANY.

The only great copper producer in Germany is the Mansfelder Kupferschieferbauende Gewerkschaft, whose cost of production is such that the profits and losses alternate as the prices of copper and of silver rise or fall. In 1903 there were mined 686,838 tons of cupriferous slate, at a cost of 28.09 marks per ton. The four smelting plants handled 685,880 tons of ore, and 474 tons of sandy ore were added in the matte smelting, so that the total was 686,354 tons. The total production of copper was 19,258 metric tons, an increase of 509 tons over 1902. This included 17,266 tons of refined copper, 1,883 tons of electrolytic, and 109 tons of refined obtained from foreign products. The desilverizing plant yielded 97,358 kilograms of fine silver. There were also made 20,785 tons of chamber acid. The average price obtained for refined copper in 1903 was 122.81 marks, as compared with 112.57 marks in 1902. The total receipts for 1903 were 30,900,828 marks, as compared with 29,044,079 marks in 1902. The expenditures were 29,117,745 marks and 29,634,971 marks, respectively, so that there was a surplus of 1,723,083 marks in 1903, as compared with a loss of 590,908 marks in 1902. The corporation carries on a number of other operations, which carried the total profit in 1903 to 6,037,853 marks, as compared with 108,110 marks in 1902.

SPAIN AND PORTUGAL.

The mines of the Peninsula are not showing any notable growth, but they continue to be an important factor in the copper trade of the world.

The Rio Tinto Company (Limited) produced, in 1903, 35,810 long tons of copper, 21,565 tons being refined copper and 14,245 tons being metal in pyrites shipped. The sales for the year were 36,361 long tons, consisting of 22,208 tons of refined copper, 1,484 tons in sulphate, and 12,669 tons in pyrites. There were mined for shipment, during 1903, 688,919 tons, as compared with 627,967 tons in 1902, and there were mined for local treatment 1,229,619 tons in 1903 and 1,237,322 tons in 1902. The average content of copper, however, declined from 2.517 per cent in 1902 to 2.390 per cent in 1903. The actual shipments were 667,748 tons of pyrites and 118,171 tons of sulphur ore. Of the pyrites shipped, the United States took 163,245 tons. The net profit on the sale of produce was £1,648,110, and there were received from interest and rents £43,613. There were paid in dividends £1,214,688.

The Tharsis Sulphur and Copper Company shipped, in 1903, 4,548 long tons of precipitate and 421,226 tons of pyrites. The net profit for the year was £218,960.

The mines of the company are approaching exhaustion and the efforts to acquire other profitable copper properties have not been successful thus far. Mines in Norway, purchased some time since, did not come up to expectations and have been disposed of.

Mason and Barry (Limited), who work the San Domingos mines in Portugal, had a fairly prosperous year, making a profit of £85,056. The copper production of the company is decreasing.

Among the more recent Spanish pyrites mines are the Pena Copper Mines (Limited), which are just beginning to produce. In 1903 the output was 179,160 tons of ore, of which 155,887 tons were put down on the heaps for leaching, the balance being reserved for export without treatment. There are now on the heaps 433,623 tons, from which there were produced, in 1902, 624 tons fine copper in precipitate, and in 1903, 924 tons. The average contents of the ore mined in 1902 was 47.24 per cent of sulphur and 1.36 per cent of copper, the percentages in 1903 being, respectively, 46.11 per cent and 1.25 per cent. The net profit in 1903 was £21,599.

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, 1896–1903.

[Long tons.]

Country.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
EUROPE.								
Great Britain	555	555	640	635	777	532	480	a 500
Spain and Portugal:								
Rio Tinto	34,501	33,923	33,705	34,370	35,732	35,348	34,480	35,810
Tharsis	12,000	a 11,000	a 11,150	9,448	7,965	7,427	6,710	6,320
Mason and Barry	a 3,900	a 4,300	3,600	3,600	3,460	3,729	3,330	2,430
Sevilla	1,025	810	800	1,200	1,460	1,292	1,545	1,105
Tinto and Santa Rosa	3,400	500	815	1,000	1,580	1,640	1,285	1,430
Other mines		2,550	2,305	2,550	2,675	4,185	2,440	2,645
Germany:								
Mansfeld	18,265	17,960	18,045	20,785	18,390	18,780	18,750	18,975
Other German	1,800	2,185	2,040	2,675	2,020	2,940	2,855	2,230
Austria	1,065	1,210	1,110	915	865	1,015	1,027	1,055
Hungary	205	445	430	590	490	335	485	330
Sweden	500	545	480	520	450	320	455	455
Norway	2,500	3,450	3,615	3,610	3,935	3,375	4,565	5,915
Italy	3,400	3,480	2,965	3,032	2,797	a 3,000	3,370	3,100
Russia	5,832	6,941	7,291	7,533	7,893	6,263	8,675	10,320
Turkey	....	975	470	920	520	980	1,100	1,400
Total	88,948	90,829	89,461	93,383	91,039	91,341	91,552	94,020
NORTH AMERICA.								
United States	205,384	220,571	235,050	253,870	270,588	268,782	294,423	311,627
Canada	4,190	5,938	8,040	6,731	8,446	18,496	17,486	19,321
Newfoundland	1,800	1,800	2,100	2,700	2,700	2,836	2,586	2,710
Mexico:								
Boleo	9,940	10,170	9,435	10,335	11,050	10,795	10,785	10,480
Other Mexican	1,210	a 4,200	a 7,000	a 9,000	a 11,000	a 19,635	a 30,000	a 40,000
Total	222,524	242,679	261,625	282,636	303,784	320,044	355,280	384,138
SOUTH AMERICA.								
Chile	23,500	21,900	24,850	25,000	25,700	30,780	28,930	30,930
Bolivia:								
Corocoro	2,000	2,200	2,050	2,500	2,100	a 2,000	a 2,000	a 2,000
Peru	740	1,000	3,040	5,165	8,220	9,520	7,850	7,800
Argentina	100	200	125	65	75	730	240	135
Total	26,340	25,300	30,065	32,730	36,095	43,030	39,020	40,865
AFRICA.								
Algiers	....	....	50	....	....	....	....	....
Cape of Good Hope:								
Cape Company	5,470	5,290	4,660	4,140	4,420	5,072	2,750	4,630
Namaqua Company	1,980	2,150	2,400	2,350	2,300	2,400	1,700	600
Total	7,450	7,440	7,110	6,490	6,720	7,472	4,450	5,230
ASIA.								
Japan	21,000	23,000	25,175	27,560	28,121	27,475	29,775	31,360
AUSTRALASIA.								
New South Wales	4,467	6,922	5,743	5,394	a 5,500	6,802	8,795	a 8,000
South Australia	4,877	4,705	5,000	a 6,500	a 5,386	6,770	6,847	a 7,000
Tasmania	1,928	4,956	5,200	a 9,000	a 10,000	a 12,000	a 9,650	a 9,552
Queensland	....	....	....	....	384	3,061	3,784	4,916
Total	11,272	16,583	15,943	20,894	21,270	28,633	29,076	29,468

a Estimated.

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 1903 only the gross weight of the ore and of the regulus (matte) are given. These are presented in the following table:

Copper ore and regulus or matte imported and entered for consumption in the United States, 1895–1903.

Year ending December 31—	Ore.		Matte.		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
1903	607,407,360	1,357,248	30,461,760	1,932,526	3,289,774

The fine copper content of the copper ore and matte imported has always been a difficult matter to estimate, since it varies from very low-grade ores to high-grade mattes. The country from which the material has been imported, and the valuation, has always served as a guide, but the chief reliance has been the reports of smelters and refiners in this country of the copper content of the material handled by them. The greater part of the tonnage from British North America is ore, including as it does the Le Roi ores smelted at Northport, Wash., the custom ores treated at the Tacoma and other smelters, and the copper content of the Ontario mines going to Atlantic tide-water works. Besides this there are the nickel-copper mattes of the Sudbury district, the copper content of which is reported to this office.

The imports of ore and of matte are shown in the following table for the calendar years 1901, 1902, and 1903:

Imports of copper ore and matte, by countries, in the calendar years 1901, 1902, and 1903.

Country.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Germany	153	$45,219	169	$43,232	175	$47,383
United Kingdom	1,011	53,498	3,999	139,281	686	104,396
British North America	55,641	3,059,815	154,737	2,318,616	243,918	1,758,013
Mexico	30,469	9,378,197	22,264	6,127,894	39,261	1,254,368
South America	8,470	2,130,305	364	62,463	77	2,865
All other countries	303	25,611	43	4,294	794	10,207
Total	96,047	14,692,645	181,566	8,695,780	284,911	3,177,232

Since July, 1903, the Bureau of Statistics has collected figures showing the fine copper content of this material. The following table presents the figures for the six months ending December 31, 1903:

Imports of copper ore, matte, and regulus into the United States for six months ending December 31, 1903.

Country.	July. Quantities.	July. Value.	August. Quantities.	August. Value.	September. Quantities.	September. Value.	October. Quantities.	October. Value.
United Kingdom:								
Long tons	....	....	306	$41,780	....	....	....	....
Pounds	....		287,954		....		....	
Germany:								
Long tons	10	$2,539	....	....	31	$8,200	....	....
Pounds	17,076		....		54,930		....	
British North America:								
Long tons	18,996	95,389	22,776	128,182	35,664	158,331	20,855	$110,698
Pounds	1,035,555		1,294,459		2,561,835		1,041,671	
Mexico:								
Long tons	5,949	177,387	2,457	85,621	323	17,352	2,542	84,301
Pounds	1,451,994		702,760		143,816		656,152	
Cuba:								
Long tons	....	....	....	....	84	504	....	....
Pounds	....		....		5,040		....	
South America:								
Long tons	....	....	21	918	....	....	....	....
Pounds	....		7,346		....		....	
Total:								
Long tons	24,955	275,315	25,560	256,501	36,102	184,387	23,397	194,999
Pounds	2,504,625		2,292,519		2,765,621		1,697,823	

Country.	November. Quantities.	November. Value.	December. Quantities.	December. Value.	Total, six months. Quantities.	Total, six months. Value.
United Kingdom:						
Long tons	....	....	....	....	306	$41,780
Pounds	....		....		287,954	
Germany:						
Long tons	....	....	1	$350	42	11,089
Pounds	....		2,205		74,211	
British North America:						
Long tons	16,791	$144,564	27,643	122,957	142,725	760,121
Pounds	1,373,379		1,552,009		8,858,908	
Mexico:						
Long tons	3,383	96,976	5,156	197,238	19,810	658,875
Pounds	746,851		1,685,957		5,387,530	
Cuba:						
Long tons	701	8,475	....	....	785	8,979
Pounds	212,848		....		217,888	
South America:						
Long tons	7	1,314	49	633	77	2,865
Pounds	8,355		6,330		22,031	
Total:						
Long tons	20,882	251,329	32,849	321,178	163,745	1,483,709
Pounds	2,341,433		3,246,501		14,848,522	

NOTE.—The pounds given in this table are the estimated copper content of the ore, etc.

A study of these returns and of the reports from smelters and refiners justifies the estimate of 32,000,000 pounds for the fine copper content of the ore and matte imported during 1903.

The growth of the Bessemerizing plants at the smelting centers tends to restrict more and more the shipment of matte, so that foreign copper reaches us more and more in the form of converter bars, which appear with ingots in the import returns. This source of uncertainty in the international movement of copper material tends, therefore, to disappear.

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 1901, 1902, and 1903:

Imports of copper pigs, bars, ingots, plates, old and other unmanufactured, in the calendar years 1901, 1902, and 1903.

Country.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
France	1,022,178	$159,344	848,523	$105,545	1,426,279	$214,297
Germany	3,117,951	537,409	1,245,354	169,202	1,600,766	218,000
United Kingdom	43,838,699	7,589,801	27,762,888	4,003,936	18,788,558	2,994,404
British North America	953,576	100,460	386,361	40,373	15,923,760	1,840,604
Cuba	1,013,460	125,255	801,016	82,921	467,832	50,687
Other West Indies	890,205	43,635	190,972	15,397	317,112	31,555
Mexico	23,024,376	3,245,564	68,565,175	8,245,926	89,361,100	10,978,497
Japan	224,850	33,185	2,643,913	316,662	3,604,643	422,756
All other countries	241,115	27,563	690,416	71,197	4,717,945	511,348
Total	73,826,410	11,812,216	103,129,568	13,051,159	136,707,995	17,262,148

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.

Copper imported and entered for consumption in the United States, 1890–1903.

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	109,840		
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	62,404,489	9,931,059	3,354,756	378,957		
1901	71,001,713	11,478,422	2,818,757	325,859		
1902	112,420,253	12,615,703	2,119,031	219,267		
1903	132,762,334	16,784,082	3,285,597	339,514		

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
1903	34,973	17,899	3,071	373	10,335	17,152,203

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, 1890–1903.

[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	958,879	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	219,666	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
1903	137,659	855,367	310,729,524	41,170,059	2,339,729	44,365,155

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 1898, 1899, 1900, 1901, 1902, and 1903, and countries to which exported.

[Pounds.]

Country.	1898.	1899.	1900.	1901.	1902.	1903.
United Kingdom	88,443,870	50,675,849	63,522,445	36,819,100	88,972,029	47,140,717
Belgium	13,613,183	5,069,456	12,554,191	4,561,405	8,431,560	4,207,720
France	53,909,508	58,450,866	67,725,989	34,607,042	63,519,881	53,745,221
Germany	42,891,345	49,285,189	67,348,848	37,487,180	56,604,753	71,130,077
Netherlands	72,418,633	69,304,699	101,898,394	61,752,002	96,358,472	96,927,346
Italy	3,733,672	3,449,565	5,550,285	5,045,775	9,108,904	7,774,016
Russia	7,340,276	2,689,610	5,650,423	2,889,270	a28,539,742	10,411,679
Austria	7,478,730	6,354,287	11,258,115	8,616,964		b16,516,663
Mexico	258,975	285,222	296,684	217,437	251,812	165,283
British North America	1,523,505	985,525	1,616,778	1,232,577	2,811,835	2,644,831
West Indies	6,143	5,599	1,317	3,032	97	....
Other countries	343,065	270,514	1,050,282	1,018,044	69,764	63,971
Total	291,955,905	246,826,331	337,973,751	194,249,828	354,668,849	310,729,524

a Other Europe, including Austria and Russia. b Other Europe.

The recovery of the export trade, which followed the collapse of the effort to hold prices up to a high level in 1901, 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 there were exported of foreign copper in 1899, 2,550,149 pounds; in 1900, 1,281,782 pounds; in 1901, 12,888,083 pounds; in 1902, 11,629,877 pounds; and in 1903, 2,093,103 pounds. In addition, 14,446 long tons of foreign copper ore, matte, and regulus were exported in 1902, and 5,150 long tons in 1903.

The following table shows the ports from which copper was exported:

Domestic exports of ingots, bars, and old copper in 1898, 1899, 1900, 1901, 1902, and 1903, by ports.

[Pounds.]

District.	1898.	1899.	1900.
Baltimore, Md	87,027,133	90,786,853	86,264,231
Boston and Charlestown, Mass	439,368	1,568,197	1,496,387
Newark, N. J	673,180	....	....
Newport News, Va	2,638,868	4,085,580	2,016,000
Norfolk, Va	5,249,820	4,707,267	....
New York, N. Y	178,400,314	134,412,540	230,178,643
Philadelphia, Pa	68,624	2,733,692	12,468,680
New Orleans, La	15,508,831	7,459,623	3,937,850
Galveston, Tex	444,920	3,700	....
Detroit, Mich	728,689	320,121	469,819
Huron, Mich	118,827	107,562	149,525
Burlington, Vt	410,410	434,340	678,589
All other districts	246,921	206,856	314,527
Total	291,955,905	246,826,331	337,973,751

District.	1901.	1902.	1903.
Baltimore, Md	54,377,355	103,607,256	88,296,071
Boston and Charlestown, Mass	27,917	426,069	512,053
Newport News, Va	1,568,567	5,070,026	1,969,177
Norfolk, Va	....	598,339	1,771,993
New York, N. Y	133,540,150	236,622,515	211,879,055
Philadelphia, Pa	3,526,130	5,804,743	3,845,307
New Orleans, La	1,806	1,819	3,014
Detroit, Mich	387,923	812,828	611,327
Huron, Mich	92,062	208,849	261,820
Burlington, Vt	434,692	....	491,921
All other districts	293,226	1,516,405	1,087,786
Total	194,249,828	354,668,849	310,729,524

The exports of copper from New Orleans in 1898 and 1899 were Mexican bars, which were shipped through that port, and were merely in transit.

The data submitted permit of the following summary showing the available supply of copper for the years 1894 to 1903, both inclusive:

Supply of copper for the United States, 1894–1903.

[Pounds.]

Source.	1894.	1895.	1896.	1897.	1898.
Production of domestic copper	354,188,374	380,613,404	460,061,430	494,078,274	526,512,987
Imports:					
Fine copper in ore and matte, entered for consumption	10,678,434	[a] 5,300,000	[a] 5,900,000	[a] 12,000,000	[a] 19,750,000
Bars and ingots	606,415	7,979,322	11,397,272	16,578,420	54,166,467
Old copper	160,592	1,336,901			
Total	365,633,815	395,229,627	477,358,702	522,656,694	600,429,454
Exports:					
Ingots and bars	162,393,000	121,328,390	259,223,924	[b] 277,255,742	291,955,905
				[c] 406,598	23,647,968
Fine copper content of matte	5,750,000	15,200,000	22,881,936	[a] 11,000,000	[a] 5,420,000
Total	168,143,000	136,528,390	282,105,860	288,662,340	321,023,873
Available supply	197,490,815	258,701,237	195,252,842	233,994,354	279,405,581

Source.	1899.	1900.	1901.	1902.	1903.
Production of domestic copper	568,666,921	606,117,166	602,072,519	659,508,644	698,044,517
Imports:					
Fine copper in ore and matte, entered for consumption	[a] 23,800,000	[a] 36,380,000	[a] 64,000,000	[d] 40,000,000	[a] 32,000,000
Bars, ingots, and old copper	71,922,340	68,796,808	73,826,406	103,129,568	136,707,995
Total	664,389,261	711,293,974	739,898,925	802,638,212	866,752,512
Exports:					
Ingots and bars—					
Domestic	246,826,331	338,121,071	194,249,828	354,668,849	310,729,524
Foreign	2,550,149	1,281,782	12,888,083	11,629,877	2,093,103
Fine copper content of matte	[a] 3,500,000	[a] 9,000,000	[a] 15,000,000	[a] 11,000,000	[a] 7,500,000
Total	252,876,480	348,402,853	222,137,911	377,298,726	320,322,627
Available supply	411,512,781	362,891,121	517,761,014	425,339,486	546,429,885

[a] Estimated.
[b] Domestic.
[c] Foreign.
[d] Deducting estimated content of foreign matte exported.

STOCKS.

All the large producers of copper, with the exception of one leading producer 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 converter 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 1903 of 537,570,584 pounds of copper out of a total of 698,000,000 pounds, had a stock of 157,215,138 pounds on January 1, 1903, and a stock of 177,117,166 pounds on January 1, 1904, thus showing an increase of about 20,000,000 pounds.

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, 1902, and 1903 being as follows:

Estimated consumption of copper in the United States in 1900, 1901, 1902, and 1903.

[Pounds.]

	1900.	1901.	1902.	1903.
Available supply	362,891,121	517,761,014	425,339,486	546,429,885
Deduct increase in producers' stocks	6,000,000	135,000,000		20,000,000
Add decrease in producers' stocks			126,348,645	
Estimated consumption	356,891,121	382,761,014	551,688,131	566,429,885

This indicates a practically stationary consumption as compared with 1902, which harmonizes well with the known developments in iron and in other metals.

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 3/4	1878	17 1/2	15 1/2
1861	27	17 1/8	1879	21 3/4	15 1/2
1862	32 7/8	20 3/4	1880	25	18 1/2
1863	38 1/2	29	1881	20 3/8	16
1864	25	39	1882	20 3/8	17 7/8
1865	50 1/2	28	1883	18 1/2	14 7/8
1866	42	26 1/2	1884	15	11
1867	29 1/4	21 1/2	1885	11 1/2	9 1/2
1868	24 1/2	21 1/2	1886	12 1/2	10
1869	26 1/2	21 7/8	1887	17 3/4	9 13/16
1870	23 3/4	19	1888	17 4/16	15 13/16
1871	27	21 1/4	1889	17 1/2	11
1872	44	27 1/2	1890	17 1/4	14
1873	35	21	1891	15	10 1/4
1874	25	19	1892	12 3/4	10 1/2
1875	23 7/8	21 1/2	1893	12 1/2	9 3/4
1876	23 1/4	18 3/4	1894	10 1/4	9
1877	20 1/2	17 1/2	1895	12 3/4	9 1/4

The following table shows the highest and lowest prices, monthly, during the last eight years:

Highest and lowest prices of Lake Superior ingot copper, by months, 1896–1903.

[Cents per pound.]

Year.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1896	10¼	9⅞	11¼	10	11⅛	10⅞	11	10⅞	11⅛	10⅞	11⅞	11⅛
1897	12	11⅛	12	11⅞	11⅞	11⅛	11⅛	11	11⅛	10⅞	11⅛	10⅞
1898	11	10$\frac{9}{10}$	11⅝	11	12	11⅞	12⅛	11⅞	12⅛	12	11⅞	11⅝
1899	17	13¾	18	17	18	17	19⅛	18	19¼	18⅛	18⅛	18
1900	16⅛	16¼	16⅛	16	17	16¼	17¼	17	17¼	16⅛	16⅛	16¼
1901	17	16⅝	17	16⅞	17	16⅞	17	17	17	16⅞	17	16⅞
1902	13	10⅞	13¼	12	12⅛	12⅛	12¼	12	12⅝	12	12⅝	12¼
1903	12⅛	12	13⅝	12⅛	14⅞	13⅛	15	14⅝	14⅝	14⅝	14⅝	14¼
Year.	**July.**		**August.**		**September.**		**October.**		**November.**		**December.**	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1896	11⅜	11	11¼	10⅞	10⅞	10⅝	10⅞	10⅛	11⅛	10⅞	11⅛	11¼
1897	11⅛	11	11¼	11	11⅝	11¼	11¼	11	11	10⅝	11	10⅞
1898	11⅝	11⅛	12¼	11⅝	12¼	12⅛	12⅛	12¼	12⅝	12⅛	12⅞	12⅝
1899	18⅛	18¼	18⅛	18¼	18⅛	18¼	18⅛	17	17¼	17	17	16⅛
1900	16⅛	16⅛	16⅝	16⅛	16⅞	16⅝	16⅞	16⅝	17	16⅝	17	16⅝
1901	17	16⅝	16⅝	16⅛	16⅝	16⅛	16⅞	16⅛	16⅝	16¼	16⅛	12⅞
1902	12⅛	12	12⅛	11⅝	12	11⅝	12¼	11⅝	12	11⅛	12⅛	11⅛
1903	14¼	13	13¼	13	13⅛	13⅝	14	12⅝	14	12⅛	12⅛	11⅝

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 Lake copper. The following table gives the results for 1902 and 1903:

Average selling prices of Lake copper in 1902 and 1903.

Mine.	1902.		1903.	
	Quantity sold.	Average price per pound.	Quantity sold.	Average price per pound.
	Pounds.	*Cents.*	*Pounds.*	*Cents.*
Tamarack	15,961,528	11.87	15,286,093	13.02
Osceola	13,416,396	11.78	16,059,636	13.00
Atlantic	4,949,366	11.88	5,505,578	13.12
Isle Royal	3,569,748	11.91	3,134,601	13.12
Baltic	6,285,819	11.87	10,580,997	13.43
Champion	....	....	10,564,147	13.37
Trimountain	....	....	9,237,051	13.43
Winona	....	....	1,039,944	13.49
Quincy	....	....	18,498,288	13.24
Franklin	....	....	4,712,888	13.72
General average	....	11.86	....	13.26

The following table shows the fluctuations in prices in the English market:

Average value of copper in England, 1898–1903.

[Per long ton.]

Year.	Standard copper.			Best selected copper.		
	£	s.	d.	£	s.	d.
1897	49	2	6¾	52	5	2
1898	51	16	7½	55	8	10
1899	73	13	8¼	78	2	0
1900	73	12	6¼	78	8	9
1901	66	19	8¼	73	8	8
1902	52	11	5¼	56	12	7
1903	58	3	2	62	14	7¾

In detail the fluctuations, monthly, of good merchant copper in the English market were as follows, from 1897 to 1903, inclusive:

Fluctuations in good merchant copper in England, 1897–1903.

[Per long ton.]

Month.	1897.			1898.			1899.			1900.			1901.			1902.			1903.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
January	50	10	8¼	48	19	2	62	18	1½	70	14	2	71	17	0	48	10	1	53	13	7¼
February	51	6	6	49	12	8¼	72	16	0	74	4	9	71	5	4	55	5	7	57	10	6¾
March	50	4	0¼	50	13	2½	69	1	0¼	78	0	4	69	13	2	53	10	8	64	0	7½
April	48	16	9	51	14	2½	74	10	0¾	78	7	1	69	14	10	52	18	7	61	19	1½
May	48	10	11½	51	9	9¾	77	5	11	74	1	8	69	15	7	54	3	10	61	18	5
June	49	1	1½	50	8	0	76	2	0½	71	14	3	68	18	9	54	0	0	57	11	3¾
July	48	1	0¼	50	3	1	76	19	3½	72	11	5	67	14	8	52	19	9	56	16	10½
August	48	12	10¼	51	10	7½	76	4	7¼	73	12	5	66	9	0	52	1	9	58	12	0
September	49	8	5	52	2	8¾	76	15	7	73	4	11½	66	2	0	52	16	4	56	19	3¾
October	48	10	3	53	8	2	75	3	10¼	72	7	7¼	64	4	7	52	6	9	55	15	0¾
November	48	0	11½	55	18	8¼	74	8	5½	72	9	3¾	65	12	2	51	3	2	56	11	2¼
December	48	7	0¼	55	18	11¼	71	19	8	72	2	3½	52	9	3	51	1	0	56	10	0

THE COPPER MARKET IN 1903.

The year opened with copper fairly active on both sides of the Atlantic, and the market, which was 12 cents for Lake copper and 11¾ cents for electrolytic copper, gradually hardened until at the end of January 12½ and 12¾ cents was paid for Lake and 12⅝ cents for electrolytic copper. The metal developed further strength in February, closing at 13⅝ cents for Lake and 13¼ cents for electrolytic. During March the demand continued unabated, the price being carried up from 13½ cents to 14⅝ cents for Lake in the last few days. The movement culminated in the latter part of April with 15 and 15⅛ cents for Lake and 14¾ cents for electrolytic copper. An uneasy feeling in financial circles in this country and a weakness in the London speculative market caused consumers to hold aloof, and Lake copper receded to 14¾ cents and electrolytic to 14½ cents. May was dull, with Lake copper hovering close to 14¾ cents. In June the range was a narrow one, although some good sales were effected. The month closed with Lake down to 14¼ cents and electrolytic to 14 cents. The financial outlook being increasingly uncertain, the copper market yielded rapidly in July, coming down to 13 cents for Lake and 12¾ cents for electrolytic. This brought out buyers, and in the middle of August a somewhat better feeling in financial circles was reflected by a rise to 13⅞ cents. The markets were dull and somewhat irregular in September, closing at 13⅝ and 13½ cents. October brought sagging prices, and the decline had reached 12¾ cents for Lake and 12½ cents for electrolytic, when suddenly the announcement came on the 23d of October that all the mines and smelting works of the Amalgamated Copper Company had been closed down. This brought a rush of buyers on both sides of the Atlantic, our market rising to 13¾ and 14 cents for Lake copper, to which the market settled down, until, as suddenly as they had ceased, operations at the Amalgamated properties were resumed on November 11. There was an immediate decline, aided by the general stagnation in all industrial activities, and November closed dull at 12½ cents for Lake and 12⅝ cents for electrolytic copper. Heavy selling pressure on the part of the large producing interests caused a further decline in the early part of December to 11¾ and 12 cents for Lake and 11½ to 11¾ cents for electrolytic copper. At these prices very large purchases were made for European account, and the year closed with the market tending upward, at 12⅛ and 12¼ cents for Lake and 12 to 12⅛ cents for electrolytic copper.

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 69,2[illegible]4
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
1903	62,879	70,047	132,926	76,305	d 56,621

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 1903, 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, 1896–1903.

[Long tons.]

Character.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Pure in pyrites	14,726	15,576	16,626	17,529	18,519	16,339	15,279	18,398
Pure in precipitate	23,160	25,932	21,558	24,387	23,462	22,037	17,874	18,216
Pure in ore	12,499	11,980	14,576	19,511	17,886	16,683	15,038	14,649
Pure in matte	25,013	22,639	18,966	21,300	24,827	27,755	21,988	22,784
Bars, cakes, etc	60,458	60,428	67,978	58,880	70,247	66,764	90,022	62,879
Total	135,856	136,555	139,704	141,610	154,941	149,578	160,201	136,926

Messrs. James Lewis & Son, of Liverpool, estimate as follows the imports of copper products into Liverpool, Swansea, London, and outports (except Newcastle and Cardiff, estimated in recent years at about 6,000 tons):

Imports of copper into Liverpool, Swansea, and London, 1896–1903.

[Long tons.]

Country.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Chile	15,923	14,982	17,734	19,752	19,875	24,624	23,789	20,968
United States	39,676	32,792	38,979	20,773	32,256	21,426	43,632	19,255
Spain and Portugal	6,298	7,697	7,293	7,084	9,721	7,780	7,860	8,189
Spain and Portugal (precipitate)	11,474	17,386	15,664	16,847	17,028	16,354	13,592	12,998
Spain and Portugal (pyrites)	14,726	15,576	16,626	17,529	18,519	16,339	15,279	18,398
Australasia	10,635	10,218	13,409	17,085	19,977	20,586	26,261	21,848
Cape of Good Hope	5,905	7,575	9,381	7,076	8,927	8,284	6,050	7,891
Venezuela	107	21	....	....	....	....	....	....
Japan	3,492	3,654	2,086	7,812	6,763	7,820	5,331	5,748
Italy	418	100	177	157	119	20	....	110
Norway	528	130	....	182	679	728	523	622
Canada	....	127	....	10	25	....	431	....
Newfoundland	2,467	2,484	1,359	2,044	1,589	1,669	1,100	1,286
Mexico	7,792	6,217	4,888	5,679	8,781	8,268	7,945	9,681
Peru	741	998	3,041	5,163	8,220	9,512	7,580	7,797
Plata River	94	190	124	63	73	84	212	134
Other countries	797	1,613	1,807	8,232	3,633	4,756	1,289	2,850
Total tons fine	121,073	121,760	132,568	135,488	156,185	148,250	160,904	137,775

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, 1890–1903.

[Long tons.]

Country.	1890.	1891.	1892.	1893.	1894.	1895.	1896.
England:							
Ore	5	4	18	23	5	....	....
Matte	18,897	19,109	24,668	20,700	2,133	8,337	10,016
Bars and ingots	1,269	7,007	1,427	14,924	28,357	12,250	29,780
Total	20,171	26,120	26,113	35,647	30,495	20,587	39,796
France	1,733	8,329	4,340	12,483	9,248	11,806	21,998
United States into England and France	21,904	34,449	30,453	48,130	39,743	32,393	61,794

Country.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
England:							
Matte	5,259	2,181	354	2,767	6,299	2,899	148
Bars and ingots	27,591	36,790	20,739	29,267	15,112	10,733	19,080
Total	32,850	38,971	21,093	32,034	21,411	13,632	19,228
France	26,165	22,753	24,695	29,100	14,008	29,455	23,961
United States into England and France	59,015	61,724	45,788	61,134	35,419	73,087	43,189

The exports of copper from Great Britain, estimating the fine contents of alloys, have been as follows:

Exports of copper from Great Britain, 1897–1903.

[Long tons.]

Character.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
English, wrought and unwrought, and sheets	35,951	40,223	42,992	28,632	37,753	35,379	40,081
Yellow metal, at 60 per cent	6,609	6,172	4,156	5,279	5,497	7,901	8,519
Brass, at 70 per cent	3,936	3,733	3,994	4,224	4,072	4,462	5,210
Sulphate of copper	14,844	13,078	10,045	10,728	9,004	10,822	13,361
Total	61,340	63,206	61,187	48,863	56,326	58,564	67,171
Fine foreign	10,046	13,242	24,129	18,862	23,074	21,414	9,134
Total	71,386	76,448	85,316	67,725	79,400	79,978	76,305

THE GERMAN COPPER TRADE.

Germany is an increasingly important factor as a consumer and manufacturer in the copper trade of the world. As will be observed from the following estimate of the consumption, by Aron Hirsch & Sohn, of Halberstadt, Germany, has quite recovered from the depression of the years 1901 and 1902:

Copper consumption of Germany, 1896–1903.

[Metric tons.]

	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Importations, except ores:								
From the United States	42,504	50,420	52,473	47,742	66,264	42,422	60,274	64,072
From other countries	25,619	28,983	33,299	37,504	33,856	30,616	31,475	36,715
Total	68,123	79,403	85,772	85,246	100,120	73,038	91,749	100,787
Less reexports	12,452	12,568	14,957	20,304	15,618	14,825	13,571	14,618
	55,671	66,835	70,815	64,942	84,502	58,213	78,178	86,169
Production inclusive of content of imported ores	29,489	29,468	30,704	37,676	32,423	31,572	30,728	30,149
Home consumption	85,160	96,303	101,519	102,618	116,925	89,785	108,906	116,318
Exports of manufactures	33,889	33,091	36,724	40,175	46,939	42,240	45,261	61,272

Aron Hirsch & Sohn have for some years estimated the sources of copper consumption, and have reached the following figures:

Consumption by manufacturers' requirements, 1900–1903.

[Metric tons.]

Use specified.	1900.	1901.	1902.	1903.
Electrical works	43,000	26,000	37,000	46,000
Copper rolling mills (rods and sheets)	18,000	16,000	18,000	18,000
Brass rolling mills and wire works	35,000	29,000	32,000	32,500
Chemical works and blue vitriol	2,000	2,000	2,000	2,000
Shipyards, railroads, for castings, alloys, German silver, etc.	19,000	17,000	19,000	18,500
Total	117,000	90,000	108,000	117,000

It is of interest to observe that the chief cause of the fluctuations in the consumption lies with the electrical industry.

Aron Hirsch & Sohn estimate that about 15,000 to 20,000 tons of old copper pass back annually into consumption.

LEAD.

By Charles Kirchhoff.

INTRODUCTION.

Taken as a whole, the year 1903 was a prosperous one for the lead mining and smelting interests of the United States. Consumption, although not as heavy as it was in 1902, was large enough to absorb easily the increased production of our mines and to call for a considerable quantity of the metal drawn from foreign sources. Prices averaged higher than they did in 1902.

A further step in the concentration of the lead interests was taken during 1903, the United Lead Company having secured control of nearly all the manufacturing plants making sheet lead, pipe, and shot to the number of 21. It has been estimated that the annual consumption of metal by the enlarged company, which has hitherto been a producer of white lead only, is 85,000 tons. The older consolidation of white-lead plants—the National Lead Company—is estimated to require a like amount. During 1904 negotiations were carried very far toward the fusion of these two companies, which would bring a very large production of the lead manufacturing capacity of the country under one control.

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, 1825–1903.

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	1903	280,000
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, 1894–1903, 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	[a]21,000	16,437	15,403	13,430	10,520
Content Canadian ores		5,040	10,100	19,515	17,377
Content miscellaneous or unknown	....	....	2,118	844	428

[a] Estimated.

Lead content of ores smelted by the works in the United States, 1894–1903, by States—Con.

State or Territory.	1899.	1900.	1901.	1902.	1903.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Colorado	70,308	82,137	73,265	51,833	45,554
Idaho	52,154	85,444	79,654	84,742	99,590
Utah	29,987	48,044	49,870	53,914	51,129
Montana	10,227	....	5,791	4,438	3,303
New Mexico	4,856	....	1,124	741	613
Nevada	3,388	....	1,873	1,269	2,237
Arizona	3,377	....	4,045	599	1,493
California	487	520	381	175	55
Washington	862	....	1,029	1,457	538
Oregon, Alaska, South Dakota, Texas				2,184	1,765
Missouri, Kansas, Wisconsin, Illinois, Iowa, Virginia, and Kentucky	54,444	....	67,172	79,445	86,597
Total lead content American ores smelted	230,090	....	284,204	280,797	292,874
Content Mexican ores	10,293	....	11,841	8,755	....
Content Canadian ores	5,110	....	9,615	2,164	....
Content miscellaneous or unknown	772	....	804	3,975	2,831

The production of soft lead was 83,444 short tons, this being the lead obtained directly by smelting nonargentiferous ores in the works of Kansas, Missouri, Illinois, and Iowa. The balance of the 86,597 tons credited to these States, or 3,153 tons, was derived from Missouri and Kansas nonargentiferous ores by the smelting furnaces connected with desilverizing plants, which must, therefore, undergo the same allowances for loss in smelting and desilverizing that are taken into account when dealing with the argentiferous ores in the above table. The total lead content of ores which passed through both the processes of smelting and desilverizing was, therefore, 209,430 short tons. Assuming the yield to be 94 per cent, a total of 196,864 tons of commercial lead is reached. To this must be added the 83,444 tons of soft lead, and the resulting total is 280,308 short tons as the production of the United States in 1903. In order to indicate the fact that it is an estimate, this figure is rounded off to 280,000 short tons of lead.

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, 1883–1903.

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	28,696
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	81,678	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	77,788
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
1903	378,518	295,074	83,444	88,324

[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, to 9,169 tons in 1902, and to 9,579 tons in 1903.

DOMESTIC PRODUCERS.

The principal increase in the production of lead during 1903 has taken place in southeastern Missouri, although in the Rocky Mountain region the rapid development of the Coeur d'Alene mines in Idaho has more than compensated for the steady decline in the lead product of Colorado. Utah has held its own fairly well in recent years.

In southeastern Missouri steady progress has been made in spite of somewhat adverse labor conditions. The principal older producers have increased their output. Thus the St. Joe, Doe Run, Desloge, Central, and Mine la Motte companies produced 44,545 short tons of lead in 1903, as compared with 41,192 tons in 1902 and with 35,132 tons in 1901. In the case of the Desloge company this includes some lead smelted on contract by custom smelters. The St. Joe Lead Company has been making extensive improvements in its mines and in its smelting plant at Herculaneum, and is completing a large new concentrating plant at the Hoffman shaft which will considerably increase the production of lead.

The Desloge Consolidated Lead Company is also building a new mill which will add materially to its capacity. The Central Lead Company, in the Flat River district, is not expected to make quite so much lead in 1904 as was produced in 1903. The Mine la Motte property is being developed to enlarge the output under new management. The National Lead Company has prepared for an increased production. This company is completing a large and modern smelting plant at Collinsville, Ill., for the reduction of the ores and concentrates from their own mines and from other properties. Hitherto the entire production of the mines of the company in St. François County was sold to the Federal Lead Company, the Pennsylvania Smelting Company, and the Markle Lead Works. The latter were sold to the United Lead Company on June 1, 1903, and have since been shut down. The Federal Lead Company, which owns the Derby property, did not produce heavily, nor did the Commercial Lead Company, which has leased the Columbia lead property, make its normal product. In the Fredericktown district the North American Lead Company started its mill and entered the ranks of producers.

The Joplin-Galena district, in southwest Missouri and southeast Kansas, has shown a further falling off. According to local statisticians the sales of lead ores during 1903 were 28,656 tons, as compared with 31,625 tons in 1902 and with the maximum of 35,177 tons in 1901. The principal producing camps were Webb City and Carterville, with 9,830 short tons, valued at $547,060; Joplin, with 8,084 tons, valued at $431,130; Duenweg, with 3,010 tons, valued at $161,695; and Galena-Empire, with 2,842 tons, valued at $156,535. The local smelters, the Picher Lead Company, the Galena Smelting and Manufacturing Company, successors to C. V. Petraeus & Co., and the Granby Mining and Smelting Company, produced 17,343 tons of pig lead in 1903, as compared with 18,628 tons in 1902 and 15,464 tons in 1901. A certain quantity of the lead ore of the district is, however, converted directly into a pigment.

The Coeur d'Alene district, in Idaho, has become by far the most important producer of lead in the United States, the returns showing that the lead content of the Idaho ores treated by the smelters of the country amounted to nearly 100,000 short tons. The principal event of the year has been the formation of the Federal Mining and Smelting Company, which acquired the Mammoth and Standard properties, now known as the Mace mines, the Tiger-Poorman mines, at Burke, and the Empire State and Idaho properties. The company also acquired the Everett smelter, which was subsequently sold to the American Smelting and Refining Company. Among the large mines of the Coeur d'Alene which did not go into the consolidation are the Bunker Hill and Sullivan, the Hercules, and the Morning. An important undertaking which was completed during the year was the transmission of electric power from Spokane to Burke by the Washington Power Company. The line is 101 miles long and is expected to confer important advantages upon the mining and dressing plants of the district.

Colorado is declining as a producer of lead, but Leadville continues to send out a very large tonnage of low grade smelting ores. During the year the Western Mining Company was formed as a subsidiary company to the Guggenheim Exploration Company, closely identified with the American Smelting and Refining Company. It acquired the A. Y. and Minnie, the A. M. W., and the Mahala mines, of Leadville, and the Ute and Ulay mines, of Lake City.

In Utah the Park City district continues to lead, among the principal shippers of lead-silver ores and concentrates being the Daly-West and the Silver King, the former having marketed 9,086 tons of lead. A large tonnage has also come from the Bingham and Tintic districts.

SMELTING AND REFINING IN BOND.

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, 1902, and 1903.

	1901.	1902.	1903.
	Pounds.	*Pounds.*	*Pounds.*
In warehouse at beginning of year	42,379,270	33,225,677	47,817,806
Direct importation	221,030,779	200,571,318	197,813,008
	263,410,049	233,796,995	245,630,814
Deduct in warehouse at end of year	33,225,677	47,817,806	21,387,901
	230,184,372	185,979,189	224,242,913
Addition by liquidation	592,977	253,875	1,771,740
Total	230,777,349	186,233,064	226,014,653

The disposition of this was as follows:

Disposition of lead in warehouses in 1901, 1902, and 1903.

	1901.	1902.	1903.
	Pounds.	*Pounds.*	*Pounds.*
Exported	194,199,419	157,834,807	163,774,605
Withdrawn for consumption	16,035,929	14,084,741	40,074,153
Deducted by liquidation	23,373,544	60,245,134	32,164,525
Total	233,608,892	232,164,682	236,013,283

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, 1890–1903.

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
1903	41,155,130	716,128	8,972,635	255,135

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
1903	17,008	810	1,589	973,266

Lead, and manufactures of lead, of domestic production, exported, 1890–1903.

Year ending December 31—	Manufactures of lead.		Pigs, bars, and old.		Total value.
	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		
1890	....	$181,080	....	....	$181,080
1891	....	173,887	....	....	173,887
1892	....	154,375	....	....	154,375
1893	....	508,090	....	....	508,090
1894	....	456,758	....	a $41,240	497,998
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 e 160,466	b 7,725,624	223,037	433,319
1898	c 265,062	d 97,862 e 112,927	118,960	4,450	215,239
1899	c 314,348	d 115,137 e 154,496	93,115	4,286	273,919
1900	c 363,600	d 130,758 e 240,149	1,998,773	88,664	459,571
1901	490,460	178,752 230,940	4,787,107	214,842	624,534
1902	c 454,423	d 153,309 e 256,153	6,542,760	286,548	696,010
1903	364,220	d 127,530 e 357,622	112,544	6,210	491,362

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, 1902, and 1903 were as follows:

Sources of imports of lead.

Country.	1895.	1896.	1897.	1898.	1899.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
United Kingdom	8,161,411	1,365,132	1,120,528	2,326,987	317,321
Germany	1,113,148	....	....	....	....
Other Europe	36,618,228	1,235,981	1,101,151	....	111,952
Total refined pig lead	45,892,787	2,601,113	2,221,679	2,326,987	429,273
British North America	15,860,906	25,672,833	44,171,421	34,453,299	17,871,875
Mexico	138,312,146	130,388,173	137,364,677	142,030,670	173,432,976
Total ore and base bullion	154,173,052	156,061,006	181,536,098	176,483,969	191,304,851
Other countries	931,116	1,656,398	1,560,635	480,384	1,142,950
Total imports	200,996,955	160,318,517	185,318,412	179,291,290	192,877,074

Sources of imports of lead—Continued.

Country.	1900.	1901.	1902.	1903.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
United Kingdom	567,482	402,552	792,607	1,552,772
Germany	225,222	671,294	952,878	1,409,926
Other Europe	111,905	2,453	1,342,193	451,331
Total refined pig lead	904,609	1,076,299	3,087,678	3,414,029
British North America	42,139,262	52,130,002	19,464,937	19,200,806
Mexico	178,602,486	163,453,526	187,484,666	186,136,779
Total ore and base bullion	220,741,748	215,583,528	206,949,603	205,337,585
Other countries	7,147,092	8,282,502	5,195,174	4,061,872
Total imports	228,793,449	224,942,329	215,232,455	212,813,486

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 1903, and the corresponding totals for the years 1902, 1901, 1900, 1899, 1898, and 1897:

Imports of lead in ore and base bullion during the calendar year 1903, 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	47,817,806	13,416,552	14,660,800	27,481
February	44,088,434	18,201,734	6,882,416	25,806
March	43,468,390	15,923,276	9,280,918	25,603
April	37,031,992	13,896,297	7,860,288	24,534
May	29,319,386	11,476,274	10,912,397	1,165,027
June	32,177,140	22,905,571	10,266,395	41,903
July	29,641,027	17,948,598	10,755,421	63,758
August	31,490,807	20,707,529	8,998,412	10,041
September	26,971,689	11,699,200	7,732,888	59,014
October	18,736,106	17,118,432	7,286,913	47,475
November	19,666,226	19,223,653	4,923,218	217,426
December	20,216,398	15,296,859	5,710,599	63,672
January (1904)	21,887,901			
Total, 1903		197,813,975	105,270,665	1,771,740
Total, 1902		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 1903, etc.—Continued.

Month.	Withdrawn from warehouse.			Deductions by liquidation.
	For exportation.	For transportation.	For consumption.	
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
January	8,575,169	6,977,224	2,184,375	14,097,437
February	11,634,877	8,447,098	2,448,218	3,199,807
March	12,961,813	6,345,108	9,574,288	2,784,986
April	12,569,471	8,419,020	5,995,227	2,510,007
May	11,131,729	7,802,960	517,589	1,243,666
June	20,224,499	13,209,419	331,650	1,984,414
July	17,680,476	6,229,444	1,897,490	1,110,587
August	15,425,271	9,354,996	8,915,275	539,558
September	13,765,553	7,511,245	5,909,628	540,259
October	13,871,260	6,335,469	1,647,117	1,668,854
November	15,846,277	7,155,324	321,866	490,658
December	10,088,210	7,485,695	331,430	1,994,292
January (1904)				
Total, 1903	163,774,605	95,273,002	40,074,153	32,164,525
Total, 1902	157,834,807	96,588,390	14,084,741	60,245,133
Total, 1901	194,199,419	201,870,647	16,035,929	23,373,544
Total, 1900	195,917,622	217,565,289	15,829,631	28,842,770
Total, 1899	151,202,762	204,545,816	14,408,027	27,591,976
Total, 1898	147,978,988	163,405,296	7,844,184	28,650,385
Total, 1897	109,847,156	183,006,461	28,929,569	7,769,593

CONSUMPTION.

The consumption figured for 1901, 1902, and 1903, 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, 1894–1903.

	1894.	1895.	1896.	1897.	1898.
Supply—	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Total production desilverized lead	181,404	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, beginning 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

Estimate of the consumption of lead in the United States, 1894–1903—Continued.

	1899.	1900.	1901.	1902.	1903.
Supply—	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Total production desilverized lead	263,826	329,658	323,790	303,011	295,074
Soft lead	40,566	48,021	57,898	74,050	83,444
Imports, foreign refined	215	452	538	1,544	1,707
Stock, domestic, beginning of year			39,050	53,733	11,595
Stock, foreign in bond, beginning of year[a]	7,341	11,320	21,190	16,613	23,909
Total supply	311,948	389,451	442,466	448,951	415,729
Deduct—					
Foreign base bullion and ores refined in bond and exported	73,313	97,959	97,100	76,962	90,353
Lead in manufactures exported under drawback	1,000	1,000	1,000	1,000	1,000
Stock, domestic, close of year			53,733	11,595	9,199
Stock, foreign in bond[a]	11,320	21,190	16,613	23,909	10,694
Total	85,633	120,149	168,446	113,466	111,246
Apparent home consumption	226,315	269,302	274,020	335,485	304,483

[a] Lead in ore and bullion.

The exports of lead from foreign base bullion and ores given in the above table are from the direct returns of the refiners themselves.

The returns show clearly that the United States, with its production of 280,000 tons of lead from its own mines, does not yield enough lead for its own consumption in normal years. The returns of the Bureau of Statistics indicate that the bulk of this is supplied from the lead obtained from refining foreign, and chiefly Mexican, base bullion.

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, 1890–1903.

[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
1903	4.10	4.05	4.10	4.05	4.65	4.10	4.65	4.35

Highest and lowest prices of lead at New York City, monthly, 1890–1903—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
1903	4.35	4.30	4.35	4.10	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
1903	4.40	4.10	4.40	4.35	4.40	4.10	4.25	4.10

Prices have been under the almost complete control of the American Smelting and Refining Company, which advanced the market from 4.10 cents a pound during the early months of 1903 to 4.35 cents, New York, on March 10, and to 4.65 cents on March 13. Toward the end of April the price was restored to 4.35 cents, and in the middle of June to 4.10 cents. In September 4.40 cents was established as the price, but it was reduced to 4.10 cents again in November. In December the price was fixed at 4.25 cents. During the year, therefore, the price for lead was considerably higher than it had been in 1902.

ZINC.

By Charles Kirchhoff.

PRODUCTION.

The large production of spelter in 1902 was only slightly exceeded in 1903.

The development of the industry is shown by the following figures:

Production of spelter in the United States, 1873–1903.

Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*
1873	7,343	1892	87,260
1875	15,833	1893	78,832
1880	23,239	1894	75,328
1882	33,765	1895	89,686
1883	36,872	1896	81,499
1884	38,544	1897	99,980
1885	40,688	1898	115,399
1886	42,641	1899	129,051
1887	50,340	1900	123,886
1888	55,903	1901	140,822
1889	58,860	1902	156,927
1890	63,683	1903	159,219
1891	80,873		

In the different States the production has been as follows:

Production of spelter in the United States, by States, 1882–1903.

Year.	Eastern and Southern States.	Illinois.	Kansas.	Missouri.	Colorado.	Total.
	Short tons.	*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

Production of spelter in the United States, by States, 1882-1903—Continued.

Year.	Eastern and Southern States.	Illinois.	Kansas.	Missouri.	Colorado.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1891	[a]8,945 [b]4,217	28,711	22,747	16,258	....	80,873
1892	[a]9,582 [b]4,918	[c]31,388	24,715	16,667	....	87,260
1893	[a]8,802 [b]3,882	[c]29,596	22,815	13,737	....	78,832
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	....	89,786
1896	[a]8,139 [b]2,427	[c]36,173	20,759	14,001	....	81,499
1897	[a]7,218 [b]3,865	[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
1903	12,301	[c]47,659	88,388	9,994	877	[f]159,219

[a] Eastern.
[b] Southern.
[c] Including Indiana.
[d] Including 2,716 short tons dross spelter.
[e] Including 2,675 short tons dross spelter.
[f] Including 3,302 short tons dross spelter.

Returns have not been received from the Sandoval Zinc Company, whose output has been estimated, with the reports of former years as a guide.

CONDITION OF THE INDUSTRY.

Colorado appears for the first time as a producer of spelter, the plant of the United States Zinc Company at Pueblo, Colo., controlled by the American Smelting and Refining Company, having started during the year.

There have been quite important additions to the productive capacity during 1903. The Illinois Zinc Company, at Peru, Ill., constructed a new furnace of 800 retorts, dismantling one of the older pattern, of a capacity of 168 retorts, which would make a net increase during the year of 632 retorts. The Granby Mining and Smelting Company took over the works of Lanyon Brothers Spelter Company at Neodesha, Kans., on March 1, 1903. The La Harpe Smelting Company began to smelt ore on September 19. A second block was started on November 13, making four furnaces running from that date to the end of the year. A third block was put in operation early in the current year. The Cherryvale plant of the Edgar Zinc Company, owned by the United States Steel Corporation, was increased by 33⅓ per cent during 1903, making the capacity of the works 22,800 tons annually.

The Cockerill Zinc Company, of which Mr. A. B. Cockerill is president, was building a large new plant at Altoona, Kans., in 1903, which will be in operation during the second half of 1904. Mr. William Lanyon, long connected with the zinc industry, was building works at Caney, Kans., which are to be in operation in the summer of 1904. The Cherokee-Lanyon Zinc Company erected a new block at Gas, Kans., and the United Zinc and Chemical Company enlarged the plant at Iola, Kans. The two older plants at Girard, Kans., operating under the names of the Girard Zinc Company and the Kansas Zinc Mining and Smelting Company, were moved to Chanute, Kans., in 1903 and rebuilt. They began operating in January, 1904, under the name of the Chanute Zinc Company. Mr. A. B. Cockerill has purchased the works of the Nevada Spelter Company, at Nevada, Mo., which were partly dismantled after they had been sold to the Prime Western Spelter Company. Mr. Cockerill has repaired the plant and it is being operated in his name individually. The Graselli Chemical Company has built works at Clarksville, W. Va. The New Jersey Zinc Company is planning a large new plant in the Chicago district.

Zinc oxide.—The production of zinc oxide for 1903 is estimated at 119,124,160 pounds, exclusive of the lead-zinc pigment made directly from the ores by the United States Reduction and Refining Company, of Canyon City, Colo., which amounted to 4,950,000 pounds. This plant was increased about 50 cent during the year, but was in operation only about two-thirds of the time on account of a fire at the works.

The capacity of the oxide plant of the New Jersey Zinc Company at Palmerton was increased about one-third by the addition of 96 furnaces, completed in the latter part of 1902. These were all in operation during 1903.

THE ZINC MINES.

The production of southwest Missouri and Kansas declined quite sharply during 1903. Mr. Jesse A. Zook, of Joplin, has compiled for the Daily Globe the following statement of ore sales for 1901, 1902, and 1903, by camps:

Sales of zinc and lead ore in the Joplin-Galena district in 1901, 1902, and 1903.

Camp.	Zinc ore.				Lead ore.			
	Quantity.			Value.	Quantity.			Value.
	1901.	1902.	1903.		1901.	1902.	1903.	
	Short tons.	*Short tons.*	*Short tons.*		*Short tons.*	*Short tons.*	*Short tons.*	
Joplin	67,232	73,690	63,870	$2,436,465	12,227	10,206	8,084	$431,130
Galena and Empire	33,930	30,339	23,402	769,095	5,270	3,096	2,892	156,585
Carterville	44,348	44,693	44,917	1,539,545	8,772	9,118	9,880	547,060
Webb City	13,741				840			
Duenweg	4,235	13,679	17,600	612,515	1,479	1,640	3,010	161,695
Aurora	20,435	19,395	13,785	404,225	566	261	238	12,595
Prosperity	....	10,929	5,720	201,965	....	1,182	735	39,855

Sales of zinc and lead ore in the Joplin-Galena district in 1901, 1902, and 1903—Cont'd.

Camp.	Zinc ore.				Lead ore.			
	Quantity.			Value.	Quantity.			Value.
	1901.	1902.	1903.		1901.	1902.	1903.	
	Short tons.	*Short tons.*	*Short tons.*		*Short tons.*	*Short tons.*	*Short tons.*	
Oronogo	16,480	9,225	7,507	$257,995	877	477	221	$11,100
Zincite	9,452	7,508	6,408	219,230	176	205	128	6,915
Alba and Neck City	7,633	7,043	9,454	374,395	26	233	158	8,075
Granby	7,941	8,459	8,067	193,285	1,075	1,069	809	44,140
Carthage	4,283	5,958	6,453	130,075	10	28	199	10,330
Cave Spring	3,804	4,594	2,410	87,290	364	242	295	15,870
Spurgeon and Spring City	4,512	4,383	2,751	75,760	1,883	1,159	916	47,680
Central City and Roaring Springs	3,470 3,614	3,630	2,813	88,185	292 189	234	263	14,455
Stotts City	1,124	1,431	338	11,710	46			
Carl Junction	6,723	7,051	5,592	201,380	177		11	590
Miscellaneous	3,963	4,336	6,602	232,090	639	972	696	37,990
Total 1903			227,689	7,835,145			28,530	1,546,005
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 smaller product of 1903 is principally due to the fact that the majority of operators declined to operate their concentrating mills during the night shift. Prospecting was not active in 1901, and since it takes about two years for development after the ore has been located by the drill, comparatively few mines entered the productive stage in 1903.

For previous years the ore sales have been as follows:

Ore sales in the Joplin-Galena district, 1894–1903.

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	34,988	7,929,230
1902	256,338	30,142	9,318,421
1903	227,689	28,520	9,381,150

The average base prices, from month to month, for the ores of the district have been as follows in 1900, 1901, 1902, and 1903:

Average base prices of zinc and lead ores in the Joplin-Galena district in 1900, 1901, 1902, and 1903, by months.

Month.	Zinc, per short ton.				Lead, per 1,000 pounds.			
	1903.	1902.	1901.	1900.	1903.	1902.	1901.	1900.
January	$30.59	$26.75	$23.73	$30.23	$25.38	$21.00	$22.80	$28.00
February	31.07	27.00	23.96	29.36	25.11	21.61	22.50	27.50
March	33.33	28.00	23.70	28.45	29.27	21.65	23.10	26.50
April	32.48	28.85	24.58	28.42	29.65	21.75	22.76	26.86
May	36.22	29.23	24.88	26.92	26.43	22.00	23.69	24.50
June	35.54	34.10	24.22	25.00	26.20	22.80	23.52	22.80
July	34.78	34.37	24.38	24.23	26.28	24.00	23.49	21.85
August	35.23	32.50	23.88	25.67	26.60	24.10	22.90	23.00
September	35.15	33.00	22.82	24.55	27.56	24.50	23.16	23.00
October	32.47	33.58	24.63	24.25	27.94	24.75	23.15	22.71
November	30.10	32.10	26.15	24.45	26.85	24.95	23.14	22.80
December	30.18	29.25	28.24	25.40	26.63	25.00	22.35	22.19
Year	33.72	30.33	24.21	26.50	27.06	23.05	22.99	24.16

There has been a good deal of activity in the development of the old zinc ore districts of southwestern Wisconsin. A considerable number of new concentrating mills of the Joplin type have been erected, and it is probable that a considerably larger output will follow.

Increasing quantities of zinc ores and concentrates are coming from a number of camps in the Rocky Mountain region. Leadville has continued its shipments, a goodly share even going to the zinc smelting plant at Pueblo. Kokomo, Rico, and Creede contribute to Colorado's total. Material is also sent from the Magdalene district in New Mexico, and from Park City and Frisco, in Utah. For the first time shipments to United States smelters have been made from the Slocan district in British Columbia.

IMPORTS AND EXPORTS.

The imports of zinc in its different forms have ceased to be of any consequence. For a series of years they were as follows:

Zinc imported and entered for consumption in the United States, 1867–1903.

Year ending—	Block or pigs.		Sheets.		Old.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
June 30—	*Pounds.*		*Pounds.*		*Pounds.*			
1867	5,752,611	$256,366	5,142,417	$311,767			$1,835	$569,968
1868	9,327,968	417,278	3,557,448	203,883			1,623	622,779
1869	13,211,575	590,332	8,306,728	478,646			2,083	1,071,061
1870	9,221,121	415,497	9,542,687	509,860			21,696	947,053
1871	11,159,040	508,355	7,646,821	409,243			26,366	943,964
1872	11,802,247	522,524	10,704,944	593,885			58,668	1,175,077
1873	6,839,897	331,399	11,122,143	715,706			56,813	1,103,918
1874	3,598,570	203,479	6,016,835	424,504			48,304	676,287
1875	2,034,252	101,766	7,320,713	444,539			26,330	572,635
1876	947,822	56,082	4,611,360	298,308			18,427	372,817
1877	1,266,894	63,250	1,341,833	81,815			2,496	147,561
1878	1,270,184	57,758	1,255,620	69,381			4,892	132,026
1879	1,419,791	58,294	1,111,225	58,050			3,374	109,718
1880	8,092,620	371,920	4,069,310	210,230			3,571	585,721
1881	2,859,216	125,457	2,727,324	129,158			7,603	262,218
1882	18,408,391	736,964	4,413,042	207,082			4,940	948,986
1883	17,067,211	655,508	3,309,239	141,828			5,606	802,982
1884	5,869,738	208,852	952,253	36,120			4,795	249,767
1885	3,515,840	113,268	1,839,860	64,781			2,054	180,103
December 31—								
1886	4,300,830	136,188	1,092,400	40,320			9,162	186,620
1887	8,387,647	276,122	926,150	32,526			11,329	319,977
1888	3,825,947	146,156	295,287	12,558			12,080	170,794
1889	2,052,559	77,845	1,014,873	43,356			19,580	140,781
1890	1,997,524	101,335	781,366	43,495			9,740	154,570
1891	808,094	41,199	21,948	1,460				42,659
1892	297,969	16,520	27,272	2,216	115,208	$6,556	20,677	45,969
1893	425,183	22,790	28,918	1,985	265	21	16,479	41,275
1894	387,788	13,788	39,947	2,061	27,754	530	11,816	28,195
1895	744,301	26,782	42,513	2,773	64,398	899	9,953	40,407
1896	1,040,719	32,096	27,321	1,358	14,855	267	9,800	43,521
1897	2,905,451	109,520	15,971	786	41,643	886	11,459	122,651
1898	2,605,028	104,669	39,712	2,724	96,899	3,417	11,211	122,021
1899	2,783,329	143,557	86,878	6,354	167,954	6,932	8,824	165,667
1900	1,767,756	86,653	155,144	10,801	155,670	6,379	21,257	128,090
1901	556,434	22,766	157,787	10,467	150,168	3,277	39,549	76,059
1902	895,054	36,536	136,587	8,339	313,537	8,299	32,708	75,882
1903	403,355	19,161	258,770	8,537	325,331	11,772	10,376	49,846

Imports of zinc oxide, 1885–1903.

Year ending—	Dry.	In oil.	Year ending—	Dry.	In oil.
	Pounds.	*Pounds.*	December 31—	*Pounds.*	*Pounds.*
June 30, 1886	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	128,216	1897	5,564,763	502,357
1888	1,401,342	51,965	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	3,271,885	163,081
1893	3,900,749	254,807	1903	3,487,042	166,084

Exports of zinc and zinc ore of domestic production, 1864–1903.

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	99,871	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	76,880	7,823	....	56,115
1872	3,686	20,880	62,919	5,726	....	26,606
1873	284	2,304	73,958	4,656	....	6,960
1874	2,550	20,037	43,566	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	4,338	82,248
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	2,182,949	170,654	....	211,053
1880	13,024	42,036	1,368,302	119,264	....	161,300
1881	11,390	16,406	1,491,786	132,806	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	7,446,984	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	508,940	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	995,240	1,449,104	6,473,135	300,557	114,197	1,863,858
1903	703,760	987,000	3,041,911	163,379	71,354	1,221,733

During 1903 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 1901, 1902, and 1903.

Customs district.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
New York	24,092	$694,995	20,883	$582,229	23,722	$649,970
Philadelphia	2,039	62,145				
Galveston	291	8,512	27,817	834,520	11,227	331,350
New Orleans	13,003	402,032	290	8,600		
Newport News			587	17,610		
All other districts			185	6,145	239	5,680
Total	39,425	1,167,684	49,762	1,449,104	35,188	987,000

The following table shows the destination of the ore exports:

Exports of zinc ore, by countries, during 1901, 1902, and 1903.

Country.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Austria-Hungary			90	$2,700	80	$2,400
Belgium	13,167	$406,734	30,138	895,824	11,813	346,350
Netherlands	26,137	757,295	19,244	541,980	23,163	634,200
Germany	1	40			115	3,450
United Kingdom	120	3,615	290	8,600	17	600
Total	39,425	1,167,684	49,762	1,449,104	35,188	987,000

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 1901, 1902, and 1903.

Customs district.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
New York	3,827,740	$159,832	1,455,101	$63,731	598,336	$36,384
Philadelphia					689	49
Norfolk and Newport News	710,200	30,631	4,277,241	198,156	1,704,491	86,083
Baltimore			16,525	900	62,900	3,897
New Orleans	1,171,068	53,074	1,344	78	6,557	463
Detroit			3,838	229	179,840	10,607
Huron	936,227	38,507	196,549	9,381	183,188	10,592
All other districts	134,986	6,862	522,537	28,132	305,910	15,300
Total	6,780,221	288,906	6,473,135	300,557	3,041,911	163,379

Practically all the spelter shipped from Atlantic coast ports is the high-grade spelter made from New Jersey and Virginia ores.

The destination of the exports of zinc is shown in the following table:

Exports of zinc, by countries, during the calendar years 1901, 1902, and 1903.

Country.	1901. Quantity.	1901. Value.	1902. Quantity.	1902. Value.	1903. Quantity.	1903. Value.
	Pounds.		*Pounds.*		*Pounds.*	
Belgium	83,545	$3,770				
Germany	1,000	50	162,351	$7,394		
Netherlands			68,851	3,197		
United Kingdom	5,167,274	218,841	5,256,329	237,345	1,767,391	$89,985
Canada	1,035,020	43,753	234,390	12,256	401,584	23,305
All other countries	493,382	22,492	751,214	40,365	872,936	50,089
Total	6,780,221	288,906	6,473,135	300,557	3,041,911	163,379

CONSUMPTION.

The consumption of spelter was satisfactory in 1903, the requirements of the galvanizing and brass industries being good until the closing months of the year. The reports of stocks are more complete than they have been in the past. Producers who in 1903 made 99,224 short tons of spelter, reported their stocks to be 9,926 short tons on January 1, 1904, as compared with 6,407 short tons on January 1, 1903. The following table gives an estimate based on the data available:

Estimated consumption of spelter, 1896–1903.

	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Production	81,499	99,980	115,399	129,051	123,886	140,822	156,927	159,219
Imports	428	1,279	1,303	1,392	961	357	448	202
Add decrease of stock during year		1,768	2,014	897		3,908		
Total supply	81,927	103,027	118,716	131,340	124,847	145,087	157,375	159,421
Deduct—								
Exports of foreign	4		18		23			
Exports of domestic	10,130	14,245	10,499	6,755	22,410	3,390	3,237	1,521
Increase of stock during year	1,675				3,015		1,456	3,519
Total	11,809	14,245	10,517	6,755	25,448	3,390	4,693	5,040
Apparent home consumption	70,118	88,782	108,199	124,585	99,399	141,697	152,682	154,381

Consumption, therefore, was very well maintained in 1903.

PRICES.

The spelter market early in the year displayed a hardening tendency, after opening with prices as low as 4.55 to 4.57½ cents at New York. Month after month prices advanced steadily until 5.75 cents was reached as a minimum in May and June, and as high as 6.25 cents was paid. Six cents as a minimum was paid in September and October. November, however, brought the general uneasiness in the metal trades, and with it the market declined quite rapidly in that month and in December, the market closing at 4.62½ cents.

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, 1896–1903, by months.

[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
1903	4.90	4.55	5.05	4.97	5.75	5.05	5.75	5.50

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
1903	5.80	5.75	6.25	5.75	6.25	5.87	6.00	5.80

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
1903	6.10	6.00	6.12	6.00	6.00	5.25	5.25	4.65

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, 1896–1903.

[Long tons.]

Country or district.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Rhine, Belgium, and Holland	179,730	184,455	188,815	189,955	186,320	199,285	200,140	215,690
Silesia	95,875	94,045	97,670	98,590	100,705	106,385	115,280	116,835
Great Britain	24,880	23,550	27,940	31,715	29,830	29,190	39,610	43,415
Austria and Italy	9,255	8,185	7,115	7,190	6,975	7,700	8,460	9,025
France and Spain	28,450	32,120	32,135	32,955	30,620	27,265	27,030	27,920
Poland	6,165	5,760	5,575	6,225	5,875	5,935	8,150	9,745
Total	344,355	348,115	359,250	366,630	360,325	375,760	398,670	422,630
United States	72,767	89,268	103,061	115,224	110,612	125,734	140,114	142,159
Total world's production	417,122	437,383	462,311	481,854	470,937	501,494	538,784	564,789
United States percentage of world's production	17.4	20.4	22.3	23.9	23.5	25.1	26.0	25.2

The leading producers are Vieille Montagne, with 76,905 long tons; Hohenlohe, with 28,575 tons; Schlesische Actien-Gesellschaft, with 27,445 tons; the Lanyon Zinc Company; G. von Giesche's Erben, with 26,160 tons; and the Edgar Zinc Company, followed by the Stolberg Company, with 20,750 tons, and the Société Asturienne, with 20,330 tons.

According to the annual report of the Vieille Montagne Company, the production of spelter was 84,906 metric tons, the rolling mills having produced 68,313 tons of sheet zinc, and the zinc-white works 10,450 tons. The gross profit was 7,505,704.99 francs and the net profit 6,256,017.81 francs. There were placed to reserve 2,145,203.56 francs; 457,601.78 francs went to the administration, 114,400.44 francs to the directors, and 3,600,000 francs were distributed as dividends.

The Société Anonyme Métallurgique de Prayon produced 13,352 metric tons of spelter and made a gross profit of 767,990 francs. After writing off, there were left 449,137.36 francs net profit, out of which dividends aggregating 325,000 francs were paid, while 81,075.28 francs went to the administration.

The zinc mines of Upper Silesia in 1903 produced 208,785 metric tons of calamine, valued at 1,774,792 marks; 343,968 tons of blende, valued at 18,676,294 marks; 7,643 tons of pyrites, valued at 8.14 marks per ton; and 5,470 tons of lead ore, valued at 76.70 marks per ton. There were employed 8,597 men, those over 16 years of age earning 830.80 marks per annum and those under 16 years earning 227.45 marks per annum, and 2,640 women, who earned an average of 285 marks per annum.

The number of zinc works was 23, and they employed 6,792 men and 1,275 women, whose wages were 6,959,638 marks. The men over 16 earned 982.61 marks per annum; the boys under 16 years 277.47 marks, and the women 338.57 marks per annum. The consumption of materials was 103,669 tons of calamine, 281,289 tons of zincblende, 1,707 tons of furnace accretions, and 4,545 tons of zinc ashes. There were also consumed 1,225,007 tons of fuel and 48,085 tons of fire clay. The production was 118,522 tons of spelter, valued at 46,753,863 marks; 16,745 tons of cadmium, valued at 81,649 marks; and 1,318 tons of lead, valued at 285,634 marks.

The rolling mills employed 792 workers, to whom 645,089 marks were paid in wages. The consumption of spelter was 39,080 tons, and the product was 38,039 tons of sheet zinc, 377 tons of lead, and 454 tons of by-products, with a total value of 17,545,177 marks.

One zinc-white plant produced 1,107 tons of zinc white.

ALUMINUM AND BAUXITE.

By Joseph Struthers.

ALUMINUM.

PRODUCTION.

The production of aluminum in the United States during 1903 is estimated at 7,500,000 pounds, as compared with 7,300,000 pounds in 1902, and 7,150,000 pounds in 1901. It has not been possible to obtain exact statistics of the production of aluminum, but judging from the extension of the uses of the metal and its alloys for such constructional and decorative work as requires lightness and no great strength, together with the increased quantity of aluminum, in the form of wires and bars, used to replace copper for conducting the electric current, it is fair to assume that the production of the light metal in the United States is steadily on the increase. This assumption is strengthened by the fact that the quantity of bauxite (the crude mineral from which aluminum is extracted) consumed during the last few years has been successively larger and larger, the consumption being based on the domestic production plus the quantity imported.

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, 1883–1903.

Year.	Quantity.	Year.	Quantity.
	Pounds.		*Pounds.*
1883	83	1895	920,000
1884	150	1896	1,300,000
1885	283	1897	4,000,000
1886	3,000	1898	5,200,000
1887	18,000	1899	6,500,000
1888	19,000	1900	7,150,000
1889	47,468	1901	7,150,000
1890	61,281	1902	7,300,000
1891	150,000	1903	7,500,000
1892	259,885	Total	48,462,779
1893	333,629		
1894	550,000		

It is to be regretted that the secretive policy concerning the development of the industry continues to be pursued by the various companies manufacturing aluminum. Doubtless a free interchange of ideas on the reduction, refining, and working of the light metal, as well as on the special practice followed in making its various alloys, would help to develop this branch of the metal industry, and in consequence benefit each and every contributor to the general fund of knowledge. The rapid and phenomenal progress in the iron and steel industry in the United States is largely attributable to the willingness of each individual manufacturer to describe and discuss his own practice, and thus, by cooperation, help the others, and in turn be helped by them.

At the present time five companies having 10 plants at different localities are engaged in producing metallic aluminum by the electrolytic process. Metallic aluminum is the sole product of the works operated by the Pittsburg Reduction Company; all of the foreign companies manufacture other electrolytic products as well.

Aluminum works in America and Europe, 1903.

Name of company.	Location of works.	Horsepower.		Process.	Capital.
		Available.	In use.		
The Pittsburg Reduction Co.	Niagara Falls, New York	....	14,000	Hall	$1,600,000
The Pittsburg Reduction Co.	Niagara Falls, New York	....			
The Pittsburg Reduction Co.	Massena Springs, New York	1,200	....	Hall	....
The Pittsburg Reduction Co. (Royal Aluminium Co.)	Shawenegan Falls, Quebec, Canada.	6,000	5,000	Hall	....
The British Aluminium Co.	Foyers, Scotland	14,000	5,000	Heroult	3,360,000
Société Electro-Metallurgique Française.	Le Praz, Savoy, France	12,500	5,000	Heroult	2,880,000
Compagnie des Produits Chimiques d'Alais.	St. Michel, Savoy, France	6,000	2,000	Hall & Minet.	....
Aluminium-Industrie-Aktien-Gesellschaft.	Neuhausen, Switzerland	4,000	4,000	Heroult	3,077,000
Aluminium-Industrie-Aktien-Gesellschaft.	Rheinfelden, Baden, Germany.	5,000	5,000	Heroult	
Aluminium-Industrie-Aktien-Gesellschaft.	Lend Gastein, near Salzburg, Austria.	15,000	15,000	Heroult	

The chief point of interest affecting the aluminum industry in the United States during the year 1903 was the final adjudication of the many lawsuits and counter lawsuits which from time to time have been instituted in behalf of the Electric Smelting and Aluminum Company, of Cleveland, Ohio, and the Pittsburg Reduction Company, of Pittsburg, Pa. In October, 1903, the United States court of appeals rendered a decision against the Pittsburg Reduction Company (operating the Hall patents) for infringement, since 1892, of the rights of the Electric Smelting and Aluminum Company, operating the Bradley patents. The sum involved was approximately $3,000,000. On October 13, 1903, a friendly agreement was entered into by the two companies to the effect that the Pittsburg Reduction Company should pay a given sum for the quantity of aluminum made by it up to the date of the agreement, and should continue the manufacture of aluminum under license of the Bradley patents until the time of their expiration, in February, 1909, paying a royalty for all metal produced in the future; the operation of the Electric Smelting and Aluminum Company is to be restricted to the manufacture of aluminum alloys, although it may handle and sell aluminum in all forms at the works of the company at Lockport, N. Y. The settlement involved also an agreement by the Electric Smelting and Aluminum Company not to appeal the old case of the Pittsburg Reduction Company *v.* the Cowles Electric Smelting and Aluminum Company, wherein the latter company was enjoined by the United States circuit court from manufacturing aluminum metal. By the terms of this agreement there will be no future litigation between the two companies.

The patent of C. M. Hall, covering the cryolite-alumina electrolyte, was applied for July 9, 1886, and was granted April 2, 1889; but in its specifications externally heated crucibles were described. The patent of C. S. Bradley (No. 468,148), which was applied for on February 23, 1883, and granted only on February 2, 1892, covers the invention of dispensing with external heating in such electrolytic processes by the use of a sufficient electric current to keep the electrolyte in a fused condition. The Bradley patent was proved, by a suit decided in 1897, to belong to the Electric Smelting and Aluminum Company. In the early days of aluminum manufacture, Hall, at the works of the Pittsburg Reduction Company, dispensed with the external heating of the crucible, and it was decided that by so doing he infringed the Bradley patent. The case is somewhat complicated for the reason that in 1893, as a result of an action brought by the Pittsburg Reduction Company against the Cowles Electric Smelting and Aluminum Company, it was decided by the court that the latter company had infringed the Hall patent. It now appears that neither company can manufacture aluminum by its present methods without infringing a patent which is the property of the other. However, the agreement of both companies, mentioned above, removes any possible conflict and places the manufacture of the metal on a proper business basis.

The Electric Smelting and Aluminum Company apparently now controls the electric smelting industry in the United States, as, in addition to the electric smelting of aluminum, the following companies are more or less subsidiary to it: The Cowles Smelting Company, the Union Carbide Company, the British Aluminium Company, the Electric Gas Company, the Acetylene Illuminating Company, the Wilson Aluminium Company, and the Acetylene Company.

PROGRESS OF THE INDUSTRY IN THE UNITED STATES DURING 1903.

The new plant of the Pittsburg Reduction Company at Massena Springs, N. Y., was put into operation in September, 1903. The equipment includes four 300-horsepower sets generating current at 500 volts, and provision is made to extend the works up to a consumption of 12,000 horsepower should the increasing demand warrant the outlay. The St. Lawrence Water Power Company at present supplies the electric current used in the extraction of the metal. In addition to the manufacture of aluminum, this company has installed a plant for the manufacture of carbon electrodes used in the reduction furnace, and has also a wire mill under construction.

The Pittsburg Reduction Company now has the large capacity of 17,200 horsepower, which is equivalent to 4,850 tons of metal yearly, a quantity that almost equals the combined output of the European producers.

The Pittsburg Reduction Company has two plants at Niagara Falls, N. Y., the upper one using 4,000 horsepower, near the grounds of the Niagara Falls Power Company above the Falls, and the lower one on the edge of the gorge, using 6,500 horsepower, supplied by the Hydraulic Power and Manufacturing Company. The Pittsburg Reduction Company was the first manufacturing plant to use the power of the Niagara Falls Power Company in 1893, and, as an inducement, it is understood that a contract was entered into for the supply of electric current at a cost not exceeding $18 per horsepower per year, including the installation by the power company of transforming machinery at the aluminum plant.

At the upper plant the alternating current is first passed through 12 air-cooled stationary transformers, which reduce the potential of the current to 115 volts, and raise its amperage correspondingly with a conversion loss of 3 per cent. The current then passes to six 800 horsepower rotary transformers, giving a direct current of 160 volts, with an accompanying loss of another 3 per cent. Five of these rotary transformers, running at a full capacity, furnish two currents, each approximately of 10,000 amperes and 160 volts. These currents may also be produced by running all six transformers at five-sixths of their full capacity.

The details of equipment and working of the plants at Niagara Falls, as given by Prof. Joseph Richards,[a] is briefly summarized as follows:

At the upper works there are two lines of crucible furnaces, technically termed "reducing pots," each being supplied with current by uninsulated aluminum bars, each 12 inches by 1 inch in cross section, which can carry 800 amperes per square inch of section.

Each pot absorbs 65 volts and has a voltage drop of 5 volts. The electrodes are of carbon, 3 inches in diameter and 18 inches long, each carrying 250 amperes. About

[a] Electrochemist and Metallurgist, October, 1902, p. 49.

one-half the energy of the current is consumed in the chemical work of decomposing the alumina and half in maintaining the proper temperature and fluidity of the molten bath for the electrolysis—from 850° to 900° C. The efficiency of the furnace, based on the amperage, is stated to be between 80 and 90 per cent.

The bath in the crucible consists of cryolite, to which is added aluminum fluoride as the solvent, and purified alumina. The action of the current sets free metallic aluminum, which settles to the bottom of the crucible and is there collected in a molten condition; and oxygen, which combines with the carbon of the electrode and forms carbon monoxide, finally escaping to the upper surface of the material in the crucible, where it is burned to carbon dioxide, with its characteristic blue flame. Although 4,000 horsepower are used, there is no odor of chlorine in the furnace room, except during the casting of the metal or when a pot is being trimmed.

The aluminum metal produced is more than 99 per cent pure and contains on the average 0.1 per cent of iron, 0.3 per cent of silicon, and smaller quantities of copper, titanium, carbon, and sodium. The metal is cast into rough ingots, each weighing about 20 pounds, which are shipped to New Kensington, Pa., for remelting and conversion into merchant shapes.

During 1903 a furnace plant has been added, similar to the one at Massena Springs, in which to make the carbon electrodes for the electric furnaces. The company has also installed an electric furnace for refining bauxite, in order to obtain a purer product from the aluminum furnaces.

At the lower works the current, produced at the power-house by nine 750 horsepower Westinghouse dynamos, coupled direct to turbines with horizontal shafts, is carried 250 feet distant to the reduction room of the aluminum plant by means of aluminum cables having a cross-sectional area of 28 inches. Each dynamo gives a direct current of 2,000 amperes at a potential of 280 volts, the full nine supplying the 6,500 horsepower required to operate the three lines of furnaces.

The daily output of the lower plant, which is operated exactly in the same manner as the upper one, is about 11,000 pounds of metallic aluminum, which gives a total daily output from both plants of the company approximating 19,000 pounds. Early in the year 1903 the company employed 150 men at the lower works and 200 men at the upper works. The fewer number of men at the larger works is due to the fact that crude metal only from refined material is made there.

During the year 1903 H. Meissonier, of Paris, France, published his important book, L'Aluminum, Ses Propriétés, Ses Applications, 222 pages, Gauthier-Villars, Paris and New York, $2.50. The work summarizes the knowledge of aluminum acquired up to date, from the treatment of the crude ore to the refining of the metal, and its manufacture into various alloys.

PRICES OF ALUMINUM AND ITS CHIEF ALLOYS.

Despite the increasing demand for aluminum, due to the extension of its uses both as metal and as alloys, the price per pound has continued practically stationary throughout the years 1901, 1902, and 1903. The prices in the United States during the years mentioned are given in detail in the following table:

Prices per pound of aluminum and its alloys during 1901, 1902, and 1903.

	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

The price of ingot aluminum during 1903 was adjusted by an agreement between all of the aluminum producers in the world.

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	$6,071
1871		341	1882	557	6,450
1872			1883	426	5,070
1873	2	2	1884	595	8,416
1874	683	2,125	1885	439	4,736
1875	434	1,355	Dec. 31—		
1876	139	1,412	1886	452	5,369
1877	131	1,551	1887	1,260	12,119
1878	251	2,978	1888	1,349	14,086
1879	284	3,423	1889	998	4,840
1880	341	4,042	1890	2,051	7,062

Imports of crude and manufactured aluminum, 1891–1903.

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	1,289	218,851
1903	498,655	139,298			4,276	2,818	1,355	143,471

The import duty on aluminum in the United States is 8 cents per pound for ingot metal and 13 cents per sheet for manufactured metal.

PROGRESS OF THE INDUSTRY IN FOREIGN COUNTRIES DURING 1903.

In Canada, the Royal Aluminium Company, which is controlled by the Pittsburg Reduction Company, utilizes 5,000 of its 6,000 horsepower capacity in the manufacture of aluminum by the electric-furnace process. The power is supplied by the Shawenegan Water and Power Company, which has expended more than $3,000,000 in developing the power plant at Shawenegan Falls, on the St. Maurice River. The power available at the falls ranges from a minimum, during low water, of 150,000 horsepower, to a maximum, at high water, of 500,000 horsepower; of this power the company has increased its capacity so as to utilize 100,000 horsepower at the first of the year 1904.

The works of the Société Electro-Métallurgique Française, at Le Praz in Savoy, are mainly used for the manufacture of metallic aluminum, although ferrochromium and other iron alloys are also made. Among the dynamos used to generate electric power are two worthy of special note. These are of unipolar type and furnish a direct continuous current of 7,500 amperes at 35 volts when operated at 300 revolutions per minute. No commutating device is used, consequently losses by hystereses and Foucault currents are avoided. Although these dynamos are very heavy and expensive, this disadvantage is more than offset by reliability and high efficiency of working. The total water power available at the works amounts to 14,000 horsepower, from which electrical energy exceeding 7,000 horsepower is obtained by various dynamos numbering 32 in all. The current used for the electro-metallurgical work is generated by seven 6-pole Thury dynamos, giving a normal continuous current of 3,000 amperes at 110 volts, when run at a speed of 250 revolutions per minute. These dynamos, grouped in two sets of three each, holding the seventh one in reserve, generate a current of 9,000 amperes at from 110 to 130 volts (the voltage varying with the resistance of the electrolytic baths); and the work has been so satisfactory that the company contemplates the installation of an additional group of 14 machines of this same type. Aluminum is used in place of copper for conducting the electric current.

The plant of the Compagnie des Produits Chimiques d'Alais, at Calypso, near St. Michel, Savoy, France, uses a current of a potential energy of 4,000 amperes. The crucibles of the electric furnace are 1 meter long, 0.55 meter wide, and 0.20 meter deep. Copper bars are used to conduct the electric current from the dynamos to the furnaces and along the furnace sides; the carbon anodes are attached thereto by means of stirrup-shaped connections, which allow a vertical movement of any or all of the anodes as may be desired. The bath of fused material is covered with a layer of charcoal, which diminishes the loss of heat by radiation. The proper alumina content of the bath is maintained by spreading a fresh layer of the material on the top of the charcoal, and from time to time pushing small quantities of it into the molten bath. The condition of the electrolyte in each furnace is continuously indicated by the brightness of a 10-volt incandescent lamp. The molten aluminum, containing from 99.5 to 99.6 per cent of metal, is removed from the bottom of the bath every hour by tilting the furnace, which is supported on trunnions for this purpose.

During the year 1903 the works of the Aluminium-Industrie-Aktien-Gesellschaft, at Neuhausen, have been considerably extended. The second plant, situated at Lend Gastein, near Salzburg, Austria, formerly using 9,000 horsepower, has been augmented by the erection of a new power plant at Rauris, 8 kilometers distant; the height of the fall of water is 130 meters, and at present three turbines furnish 6,000 horsepower, which gives a total capacity of 15,000 horsepower at the Lend reduction works. The third plant of this company, at Rheinfelden, in Baden, Germany, has been greatly improved by the installation of apparatus for regulating the head of water. The company now has at its three plants a total of 24,000 horsepower, and a further extension of its hydraulic power is in contemplation. The chief product is aluminum, but high-grade carbide is also made, and experimental work is now being carried on in other electrolytical and electric furnace processes.

The capacity of the works of the British Aluminium Company at Foyers, Scotland, is being increased by the addition of two 520-kilowatt Dick-Kerr dynamos, with attached turbines to operate them. The manufacturing works of the company, also, are being increased in order to handle the future increased output. These factories are situated at Larne, Ireland, and at Greenock and Milton, Staffordshire, England. Toward the end of the year 1903 it was reported that the financial affairs of the company had been greatly strengthened by the repayment of the entire £10,000, which it was empowered to borrow in priority to the debenture stock.

TECHNOLOGY.

Uses.—The metal aluminum is used mainly for the transmission of electric currents, in place of copper, although a large proportion of the output is manufactured into articles for domestic and culinary use. Other uses of growing importance are,—for the construction of parts of machines and apparatus which require lightness rather than great strength; in the manufacture of special alloys; as a substitute for stone and zinc in lithographic work; and for the production of intense heat by the combustion of the metal in the powder called thermit (which is the basis of three important branches of metallurgical work).

Aluminum is also used in the manufacture of a special explosive called ammonal; in the rubber industry for making lasts and boot trees upon which rubber shoes and boots are made; in cast-iron foundry practice as a substitute for the ordinary wooden patterns; as a substitute for wood in making bobbins for spinning and weaving machines treating silk fiber; and in powdered form for the manufacture of white metallic paints, a use to which it is particularly suited on account of its nonsusceptibility to atmospheric influences. Among the proposed new uses of aluminum is its substitution for the glass carboys or earthenware vessels employed for the transportation of nitric acid, and also as a substitute for zinc in lining cisterns and other receptacles for storing water.

Electrical conductors.—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 domestic product. 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 during 1903, as is shown by two reported contracts, among many others, for 500,000 pounds and 298,245 pounds of aluminum wire, respectively. Drawn wires seem to be more suceptible to corrosion by atmospheric influence than rods, and to counteract this disadvantage the manufacturers, it is reported, are now putting on the market a so-called "weatherproof wire," which is coated with a preparation that forms a through protection for the metal. In order to overcome the difficulty encountered in soldering aluminum conducting wire, a patent was granted on March 24, 1903 (No. 723,717), to J. D. Nicholson, by which a compound ingot of copper and aluminum is drawn into a wire having a copper core and an aluminum covering. The core of copper can be readily soldered without raising the resistance of the joint.

Ammonal.—A company has been formed to manufacture, on a commercial scale, the new explosive, ammonal, which is composed of powdered aluminum and ammonium nitrate, in respective proportions depending upon the explosive strength desired. Ammonal is reported to be extremely safe to handle, impervious to water, and of great explosive strength.

Alloys.—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 very interesting summary of the progress that has been made in the manufacture and uses of aluminum alloys is given by Prof. Joseph W. Richards in a paper read before the American Society for Testing

Materials, at Delaware Water Gap, July 3, 1903, a brief abstract of which was published in the Engineering and Mining Journal, October 3, 1903. Of the numerous alloys mentioned, those with zinc are the cheapest and most efficient. Zinc-aluminum alloys containing up to 15 per cent of zinc are malleable and ductile, and castings containing as high as 33 per cent of zinc, when formed in sand molds possess a tensile strength of 25,000 pounds per square inch, and when chilled. of 40,000 pounds per square inch. A full description of the recent alloys, magnalium, Wolframium, McAdamite, aluminum-silver, albradium, and aluminum-zinc, are given in the report of this Office on aluminum and bauxite for 1902.

Thermit.—One of the most promising fields for the consumption of aluminum is the so-called thermit process, invented by Doctor Goldschmidt, which produces an intense heat by the oxidation of metallic aluminum in intimate contact with metallic oxides. The utilization of the heat so produced is of great value for welding in place steel rails and broken iron or steel castings; for reducing refractory oxides of the rare metals tungsten, chromium, and molybdenum, yielding a metallic product free from carbon; and for preventing the formation of large pipes in the tops of steel ingots. A considerable advancement in these specialties has been made abroad, but so far but little has been done in the United States. For the conduction of the electric current, especially in trolley lines, the great advantage of welding both the track and the third rail is obvious, for the reason that the ends of adjacent rails may be welded together without removal from the track at a cost stated to be less than the usual connection by means of fish plates and copper binding wires, and when the rails of a track are welded in this manner, they are practically continous and the connections are permanent, which avoids the frequent and costly repairs so necessary to maintain a perfectly good conductor for the electric current. During 1903 no less than 20,000 track joints were made by the thermit welding process. The system has been introduced into the cities of Leeds, Glasgow, and Nottingham, and an English company is using the process for welding 25 miles of rails in Singapore.

For the welding of wrought-iron pipes the thermit process has been largely used, between 30,000 and 40,000 joints having been made by it. This method is cheaper than the usual flange joint, and is of special value for pipes or tubes to be used under high pressure, or for the transportation of liquids, such as alkalies or petroleum, which attack the materials commonly used for packing.

Electroplating.—Much work has been done both in electrolytically depositing other metals on aluminum and in depositing aluminum on other metals. Various processes have been described and various patents obtained during the last year, but usually they were of little value. In many cases it is a difficult matter to obtain a sound and adherent film of metal on aluminum by electro-deposition, due in part to the porosity and irregular degree of purity possessed by commercial aluminum. The following summary of the work of Mr. A. Fischer presents[a] the chief point of aluminum progress:

Coatings of copper, silver, nickel, zinc, and tin may be obtained directly upon aluminum; but films of gold, brass, and arsenic are best applied upon a primary layer of copper, nickel, or silver. Aluminum coated with copper or silver can be "oxidized" with no attendant danger of the deposit coming off, but the use of hot solutions of alkali sulphides must be avoided, else the deposit will become blistered.

Details of the methods of treatment to be followed with the various metals are given in Mr. Fischer's paper.

WORLD'S PRODUCTION.

The following table shows the world's production of aluminum in 1900, 1901, and 1902.

World's production of aluminum in 1900, 1901, and 1902.

Country.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Metric tons.		*Metric tons.*		*Metric tons.*	
United States	3,244	$2,238,000	3,244	$2,238,000	3,311	$2,284,900
France	1,026	525,600	1,200	560,000	1,355	638,830
United Kingdom	569	364,000	560	....	600	....
Switzerland	2,500	1,225,000	2,500	1,225,000	2,500	1,201,425
Total	7,339	4,352,600	7,504	....	7,766	....

BAUXITE.

PRODUCTION.

There was a large increase in the production of bauxite in the United States during the year 1903, due mainly to the development of the industry in Arkansas, the total quantity shipped amounting to 48,087 long tons, valued at $171,306, as compared with 29,222 long tons, valued at $128,206, in 1902. These figures show an increase in quantity of 18,865 tons, or about 65 per cent, and in value of $43,100, or 34 per cent. At the present time, Georgia, Alabama, and Arkansas, in the order of their outputs, furnish the total supply of bauxite in the United States. The mineral occurs in other States, notably North Carolina and South Carolina, but the deposits are not of sufficient extent or purity to be of commercial value.

The chief factor of interest during 1903 was the completion and the putting into operation of the mining plant of the Pittsburg Reduction

[a] Electro-Chemical Industry, vol. 1, No. 16, December, 1903.

Company at Bauxite, Ark. The plant has been carefully designed with the view of replacing hand labor by machinery, wherever possible. Mechanical conveyors and elevators transport the crude ore from the cars through the mill and finally store the finished product in bins ready for shipment. A description of the mine and mill equipment is given in the Mineral Resources for 1902 under the section devoted to Aluminum and Bauxite.[a]

A second point of interest to the industry is the new refining plant of the Pittsburg Reduction Company at East St. Louis, which was put in operation during the latter part of the summer. The plant is similar in detail to the refining plant of the company at New Kensington, Pa. The crude ore, which was formerly shipped from Arkansas to New Kensington, is now refined at East St. Louis, by the soda process, which removes the impurities, iron oxide and silica. The equipment includes a bank of coke ovens for coking Illinois coal, which, so far, have given very satisfactory results.

Prior to 1890 the consumption of bauxite in the United States was mainly of ores imported from France, but the discovery and working of deposits in the United States has very appreciably reduced the proportion of the foreign ore now imported. During the last two years, however, the low ocean freight rates have rendered it commercially advantageous to import ore from France, where it is mined and placed free on board at a comparatively small expense. In fact, French ore could be laid down at New York, Philadelphia, or Baltimore, including the import duty of $1 per ton, cheaper than the crude ore could be delivered by freight from the mines in the South or West. The French ores, which contain a high percentage of iron oxide, can not be used advantageously for the manufacture of aluminum sulphate, but are utilized chiefly for making aluminum hydrate, which is used in the manufacture of the metal. Although a large part of the quantity of bauxite consumed in the United States is used for the manufacture of aluminum, a fair proportion, stated variously at from one-quarter to one-half of the total, is used in the manufacture of chemical salts of aluminum, and during the last year or so, in making artifical corundum, of which abrasive wheels are constructed. Another important use for bauxite ore that has been made abroad, but to a minor extent only in the United States, is as a refracting material for lining furnaces in which the corrosive action of the basic slag must be resisted.

The deposits of bauxite in Arkansas are situated on the hillsides, and the ore is very easily mined by first stripping the slight overburden and then blasting, which breaks down the ore and renders it easily movable by pick and shovel into wagons, and thence by tramway to the railroad. In general, nearly all of the bauxite mines con-

[a] Aluminum and Bauxite: Mineral Resources U. S. for 1902, U. S. Geol. Survey, 1904, pp. 235-236.

tain ores of different grades, which are first sorted by hand or by screen and then dried in the air naturally or in kilns or furnaces before it is in proper form for the market. Recently, for the purpose of drying the ore, a revolving cylindrical type of furnace has been used with very satisfactory results. The sorting by screens is preferable to hand sorting, when the ore will admit of this method of classification; and occasionally when clay occurs associated with the bauxite, a common log washer is used to remove the sterile clay.

If the bauxite is to be used for the manufacture of alum, it is merely crushed, dried, and shipped in bulk in box cars, but if for the manufacture of aluminum metal or artifical corundum, which requires a low silicon content, the crushed ore is first passed through a log washer in order to remove the sterile siliceous gangue.

The subjoined table gives the production and value of bauxite for each year since 1889:

Production of bauxite in the United States, 1889–1903, by States.

<table>
<tr><th>Calendar year.</th><th>Georgia.</th><th>Alabama.</th><th>Arkansas.</th><th>Total.</th><th>Value.</th></tr>
<tr><td></td><td>Long tons.</td><td>Long tons.</td><td>Long tons.</td><td>Long tons.</td><td></td></tr>
<tr><td>1889</td><td>728</td><td></td><td></td><td>728</td><td>$2,366</td></tr>
<tr><td>1890</td><td>1,844</td><td></td><td></td><td>1,844</td><td>6,012</td></tr>
<tr><td>1891</td><td>3,301</td><td>292</td><td></td><td>3,593</td><td>11,675</td></tr>
<tr><td>1892</td><td>5,110</td><td>5,408</td><td></td><td>10,518</td><td>34,183</td></tr>
<tr><td>1893</td><td>2,415</td><td>6,764</td><td></td><td>9,179</td><td>29,507</td></tr>
<tr><td>1894</td><td>2,050</td><td>9,016</td><td></td><td>11,066</td><td>35,818</td></tr>
<tr><td>1895</td><td>3,756</td><td>13,313</td><td></td><td>17,069</td><td>44,000</td></tr>
<tr><td>1896</td><td>7,313</td><td>11,051</td><td></td><td>18,364</td><td>47,338</td></tr>
<tr><td>1897</td><td>7,507</td><td>13,083</td><td></td><td>20,590</td><td>57,652</td></tr>
<tr><td>1898</td><td></td><td></td><td></td><td>25,149</td><td>75,437</td></tr>
<tr><td>1899</td><td>15,736</td><td>14,499</td><td>5,045</td><td>35,280</td><td>125,598</td></tr>
<tr><td>1900</td><td colspan="2">19,739</td><td>3,445</td><td>23,184</td><td>89,676</td></tr>
<tr><td>1901</td><td colspan="2">18,038</td><td>867</td><td>18,905</td><td>79,914</td></tr>
<tr><td>1902</td><td colspan="2">22,677</td><td>4,645</td><td>27,322</td><td>120,366</td></tr>
<tr><td>1903</td><td colspan="2">22,374</td><td>25,713</td><td>48,087</td><td>171,306</td></tr>
</table>

The figures showing the output and value of the production of bauxite during 1903 have been received directly from the individual producers, and have also been approximately confirmed by Mr. William G. Neilson, of the Republic Mining and Milling Company.

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 annual production, imports, exports, and consumption, together with the value of each, respectively.

Production, imports, exports, and consumption of bauxite in the United States, 1898-1903.

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	2,000	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
1903	48,087	171,306	14,889	49,684	*Nil.*		62,976	220,990

WORLD'S PRODUCTION.

The following table shows the world's production of bauxite in 1900, 1901, 1902, and 1903:

World's production of bauxite, 1900-1903.

Country.	1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Metric tons.		*Metric tons.*		*Metric tons.*		*Metric tons.*	
United States	23,556	$89,676	19,207	$79,914	29,785	$128,206	48,859	$171,306
France	58,530	92,596	76,620	124,168	96,900	174,685		
United Kingdom	5,873	6,750	10,357	14,515	9,192	13,395	6,226	
Total	87,959	189,022	106,184	218,597	135,877	316,286		

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 1903 the production of aluminum sulphate was 80,726 short tons, valued at $1,614,520, as compared with 80,075 short tons, valued at $1,938,671, in 1902, and that of crystallized alum was 7,574 short tons, valued at $210,910, as compared with 8,539 short tons, valued at $299,500, in 1902. These statistics do not include the production of sodium aluminate. The companies producing one or both of these salts during 1903, 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, the Merrimac Chemical Company, and the Jarecki Chemical Company.

The production and imports of alum and aluminum sulphate into the United States from 1898 to 1903, inclusive, are given in the following table:

Production and imports of alum and aluminum sulphate into the United States, 1898–1903.

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
1903	7,574	210,910	27.85	80,726	1,614,520	20.00	[b] 776	14,463	18.64

[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); in 1902, 339 short tons ($21,235); and in 1903, 1,386 short tons ($93,465).

QUICKSILVER.

PRODUCTION.

The production of quicksilver in the United States during 1903 amounted to 35,620[a] flasks of 76½ pounds each, valued at $1,544,934, as compared with 34,291 flasks, valued at $1,467,848, in 1902. an increase in quantity of 1,329 flasks, and in value of $77,086.

TEXAS.

The production of quicksilver decreased in Texas from 5,319 flasks, valued at $239,350, in 1902, to 5,029 flasks, valued at $211,218, in 1903. During the year Prof. William B. Phillips, director of the University of Texas mineral survey, published a carefully prepared statement in regard to considerable extensions of the quicksilver-bearing area in Texas. It is evident that quicksilver mining in Texas should increase for several years before reaching the maximum.

CALIFORNIA.

The product from the mines, which has been carefully described in previous reports, amounted to 30,526 flasks, worth $1,330,916. The following table gives the production of quicksilver in California since 1850:

Total production of quicksilver in California, 1850–1903.

[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	1903	30,526
1866	46,550	1885	32,073	Total	1,943,557
1867	47,000	1886	29,981		
1868	47,728	1887	[b]33,825		

[a] Including 65 flasks from Nevada.

[b] Includes 65 flasks from Oregon.

The production of quicksilver in California, by counties, for 1902 and 1903, is given in the following table:

Production of quicksilver in California, by counties, during 1902 and 1903.

[Flasks of 76½ pounds net.]

County.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
Colusa	504	$21,748	510	$21,708
Lake	3,797	161,406	2,130	85,520
Napa	7,300	311,339	7,859	359,006
San Benito	7,289	306,096	8,150	370,000
San Luis Obispo	2,546	107,686	4,592	185,430
Santa Clara	5,779	243,599	4,658	200,330
Sonoma	1,519	66,373	2,361	97,766
Trinity	238	10,251	266	11,156
Total	28,974	1,228,498	30,526	1,330,916

PRICES.

The variation in average prices for quicksilver, per flask, in San Francisco during the years 1902 and 1903, by months, is shown in the following table:

Average price of quicksilver, per flask, at San Francisco during 1902 and 1903, by months.

Month.	1902.	1903.	Month.	1902.	1903.
	Price.	*Price.*		*Price.*	*Price.*
January	$45.30	$46.00	August	$42.71	$45.25
February	44.29	46.00	September	42.85	45.33
March	45.56	45.63	October	42.37	45.25
April	45.00	45.25	November	42.64	44.50
May	44.83	45.25	December	45.00	44.50
June	45.77	45.25	Average	44.10	45.29
July	43.89	45.25			

IMPORTS.

The following table shows only slight changes in the imports of quicksilver, which have been merely nominal for the last ten years:

Quicksilver imported and entered for consumption in the United States, 1867–1903.

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	238,057	1901	1,441	789
1883	1,552,738	593,367	1902	(a)	2,166
1884	136,615	44,035	1903	(a)	1,065
1885	257,659	90,416			

a Not stated.

EXPORTS.

The following table gives the exports of quicksilver from San Francisco only during the year 1903, amounting to 10,722 flasks, valued at $446,845:

Exports of domestic quicksilver from San Francisco during 1903, by countries.

[Flasks of 76½ pounds.]

Country.	Quantity.	Value.
China (Hongkong)	5,250	$213,125
Mexico	3,326	143,474
Japan	1,370	56,475
Honduras	671	29,181
British Columbia	47	2,074
Korea	25	1,092
Costa Rica	10	449
Colombia	7	263
Salvador	6	263
Russia, Asiatic	5	225
Russian China	3	135
Nicaragua	2	89
Total	10,722	446,845

In the following table the quantity and value of quicksilver exported from the United States from 1880 to 1903, inclusive, are given:

Exports of quicksilver from the United States, 1880–1903.

[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	808,358	1895	15,542	482,065
1884	7,370	199,685	1896	19,944	618,437
1885	6,802	209,758	1897	13,173	394,549
1886	8,091	204,956	1898	12,830	440,567
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	98,192	1902	13,247	575,099
1891	3,714	145,502	1903	17,577	719,119

WORLD'S PRODUCTION AND VALUE.

The following table gives the production in metric tons and the value of quicksilver in various countries in 1899, 1900, 1901, and 1902:

World's production and value of quicksilver in 1899, 1900, 1901, and 1902.[a]

[Metric tons.]

Country.	1899.		1900.	
	Quantity.	Value.	Quantity.	Value.
United States	1,057	$1,452,745	983	$1,302,566
Austria	586	492,021	510	499,052
Italy	205	246,000	260	312,000
Russia	362	321,814	304	270,256
Spain	1,361	1,481,229	1,095	1,193,550
Total	3,521	3,993,809	3,152	3,577,444

Country.	1901.		1902.	
	Quantity.	Value.	Quantity.	Value.
United States	1,031	$1,382,305	1,190	$1,467,848
Austria	525	547,513	511	568,929
Italy	278	361,400	260	310,080
Russia	(b)	(b)	(b)	(b)
Spain	754	1,105,890	1,425	1,941,387
Total	2,588	3,397,108	3,386	4,288,244

[a] Mexico exported 324 tons of quicksilver in 1899, 335 tons in 1900, and 335 tons in 1901.
[b] Statistics not yet available.

THE STEEL-HARDENING METALS.

By Joseph Hyde Pratt.

INTRODUCTION.

There are included under the head of steel-hardening metals, nickel and cobalt, chromium, tungsten, molybdenum, vanadium, titanium, and uranium, which are named in the order of the importance of their production and use for steel-hardening purposes. In this list manganese would naturally be included, but on account of its very extensive production and very large use in the purification of steel it is treated separately.

These metals are not added to the steel to cause chemical reactions to take place, by which harmful ingredients are made to go into the slag or to pass off as gases, as is the case in the use of ferrosilicon or ferromanganese (spiegeleisen), which are added to the furnace in the original manufacture of the steel. These other ferro alloys are not added until after the steel has been manufactured, and their use is as a physical addition to the manufactured steel for the physical benefits that they confer upon it, and hence they accomplish their purpose in a manner entirely different from that of the ferrosilicon or ferromanganese.

The special steels resulting from these additions vary among themselves, having individual properties of tensile strength and elastic limit, of conductivity, heat, and electricity, of magnetic capacity, and of resistance to impact, whether as shell or as armor plate. It was only about twenty years ago that the first of these metals, nickel, began to be used to any extent for the purpose of hardening steel, but since their introduction their use for this purpose has continued to increase steadily. Experiments are still being carried on with some of these metals in order to determine their actual commercial value with regard to the qualities that they impart to steel. In the arts it is the ferro alloy of these various metals that is first prepared and is then introduced in the required quantity into the manufactured steel, but this ferro alloy is never added to the molten mass during the manufacture of the steel. All these metals give characteristic and distinct properties to steel, but in all cases the principal quality is the increase in the hardness and the toughness of the resulting steel. Some of the metals—as nickel, chromium, and tungsten—are now entirely beyond the experimental stage and are well established in the commercial world as definite steel-hardening metals, and new uses are being constantly devised for the different steels, which are causing a constant increase in their production. Others, as molybdenum and vanadium, though they have been proved to give certain positive values to steel, have not been utilized to any large extent as yet in the manufacture of molybdenum or vanadium steel, partly on account of the high cost of the ores containing these metals. Titanium and uranium are still in the experimental stage; and, although a good deal has been written as to the value of titanium as an alloy with steel, there is at the present time very little if any of it used in the manufacture of a commercial steel.

Since the introduction of the electric furnace and the consequent methods that have been devised for reducing ores, it has become possible to obtain these ferro alloys directly from the ores by reducing them in the electric furnace, and hence experiments have been conducted on a much larger scale than formerly.

The prices of the various ferro alloys vary considerably. Ferrochrome in December, 1903, was quoted at $120 to $225 per long ton of 2,240 pounds, cost, insurance, and freight, New York, on the basis of 60 per cent, with variations up and down at $1.75 per unit. Ferrotungsten was quoted at 40 cents per pound, or $896 per ton, on 100 per cent, cost, insurance, and freight, New York. Ferromolybdenum was quoted from $1.50 to $2.50 per pound, or $3,360 to $5,600 per ton, on 100 per cent, cost, insurance, and freight, New York; in May, 1904, this had dropped to $1.25 per pound on 100 per cent, cost, insurance, and freight, New York. Ferrovanadium was quoted at $7.50 per pound, or $16,800 per ton, on 100 per cent, in the English market, and $6.40 per pound in the French market; for ton lots the price has been quoted as low as $4.50 per pound. Ferromanganese has, during the last two or three years, been very steady, and on contract, 100-ton lots and over, was quoted at $50 per ton, duty paid, with freight paid east of the Mississippi River. In May, 1904, this price had dropped to $44 per ton. Ferronickel alloy and metallic nickel vary from 50 to 56 cents per pound for the nickel content.

The minerals which form the source of these metals are as follows: Nickel and cobalt are obtained from nickeliferous pyrrhotite, genthite, garnierite, and a nickeliferous lead ore such as is found at Mine Lamotte, Mo. Chromium is obtained exclusively from the mineral chromite. Tungsten is obtained from the three minerals, wolframite, hübnerite, and scheelite. Molybdenum is obtained chiefly from molybdenite, with smaller amounts from wulfenite. Vanadium is usually found associated with uranium, and is obtained from carnotite and in smaller quantity from vanadinite. Uranium is obtained chiefly from the two minerals carnotite and uraninite (pitchblende). Titanium is found chiefly as ilmenite (ferrous titanate) and rutile (titanium oxide).

MANGANESE STEEL.

Besides the use of ferromanganese for the chemical effect which it produces in the manufacture of steel in eliminating injurious substances, it is also used in the production of a special steel which possesses to a considerable degree combined hardness and toughness. Such steel contains from 0.8 to 1¼ per cent of carbon and about 12 per cent of manganese and is known as "Hadfield manganese steel." If only 1.5 per cent of manganese is added, the steel is very brittle, and the further addition increases this brittleness until the quantity of manganese has reached 4 to 5.5 per cent, when the steel can be pulverized under the hammer. With a further increase, however, of the quantity of manganese, the steel becomes ductile and very hard, reaching its maximum degree of these qualities with 12 per cent of manganese. The ductility of the steel is brought out by sudden cooling, a process the opposite of that used for carbon steel. These properties of manganese steel make it especially adapted for use in the manufacture of rock-crushing machinery, safes, and mine car wheels.

NICKEL AND COBALT.

The two metals, nickel and cobalt, are treated together for the reason that nearly all of the ores that contain one of these metals contain also a small percentage of the other, and in the reduction of the ores both nickel and cobalt go into the matte which is afterwards refined.

NICKEL STEEL.

Nickel finds its largest use in the manufacture of special nickel and nickel-chromium steels, and the use of these steels for various purposes in the arts is constantly increasing. The greatest quantity of nickel steel is used in the manufacture of armor plate, either with or without the addition of chromium. There is probably no armor or protective-deck plate made which does not contain from 3 up to 5 per cent of nickel. Nickel steel is also used for the manufacture of ammunition hoists, communication tubes, and turrets on battle ships, and for gun shields and armor.

The properties of nickel steel or nickel-chromium steel that make it especially adapted for these purposes are its hardness and great tensile strength, combined with great ductility and a very high limit of elasticity. One of the strongest points in favor of a nickel-steel armor plate is that when it is perforated by a projectile it does not crack. The Krupp steel, which represents in composition about the universal armor-plate steel, contains, approximately, 3.5 per cent of nickel, 1.5 per cent of chromium, and 0.25 per cent of carbon.

Another use for nickel steel that is gradually increasing is the manufacture of nickel-steel rails. During 1903 there were over 11,000 tons of these rails manufactured, which were used by the Pennsylvania, the Baltimore and Ohio, the New York Central, the Bessemer and Lake Erie, the Erie, and the Chesapeake and Ohio railroads. These orders for nickel-steel rails resulted from the comparison of nickel-steel and carbon-steel rails in their resistance to wear during the five months' trial of the nickel-steel rails that were used on the horseshoe curve of the Pennsylvania Railroad. The advantages that are claimed for the nickel-steel rail are its increased resistance to abrasion and its higher elastic limit, which increases the value of the rail as a girder. On sharp curves it has been estimated that a nickel-steel rail will outlast four ordinary rails.

In regard to the comparative cost of nickel-steel and carbon-steel rails an interesting comparison has been made by Mr. John McLeod,[a] which may be summarized as follows:

Comparative cost of nickel-steel and carbon-steel rails.

	Nickel-steel rails.	Carbon-steel rails.
Cost of the tonnage of rails necessary to maintain a certain curve for a given period	[a]$56.00	[b]$84.00
One ton of rails made of 3½ per cent nickel steel contains 78.4 pounds of nickel which, at 20 cents per pound, equals a credit of	15.68	
Credit for scrap rails	[a]16.00	[b]48.00
Total credit	31.68	48.00
Gross cost (as above)	56.00	84.00
Total credit (as above)	31.68	48.00
Net cost	24.32	36.00

[a] 1 ton. [b] 3 tons.

Nickel steel has also been largely adopted for forgings in large engines, particularly marine engines, and it is understood that this is now the standard material for this purpose in the United States Navy. There is a very great variety of these forgings and drop forgings, which include the axles and certain other parts of automobiles, shafting and crank shafts for Government and merchant-marine engines and stationery engines, for locomotive forgings, the last including axles, connecting rods, piston rods, crank pins, link pins, and pedestal cap bolts, and for sea-water pumps.

Another important application that is being tried with nickel steel is in the manufacture of wire cables, and during the last year such cables have been made by the American Steel and Wire Company, but

[a] Proc. Am. Soc. for testing materials, vol. 3, 1903. Reprint, p. 26.

no comparison can as yet be made between them and the ordinary carbon-steel cables with respect to their wearing qualities.

In the manufacture of electrical apparatus nickel steel is beginning to be used in considerable quantity. The properties of this steel which make it especially valuable for such uses are, first, its high tensile strength and elastic limit, and, second, its high permeability at high inductions. Thus steel containing from 3 to 4 per cent of nickel has a lower permeability at low inductions than a steel without the nickel, but at the higher inductions the permeability is higher. A notable instance of the use of this material is in the field rings of the 5,000-horsepower generators built by the Westinghouse Electric and Manufacturing Company for the Niagara Falls Power Company. These field rings require very high tensile strength and elastic limit, and in order to reduce the quantity of material it is desirable that they have high permeability at high inductions. This result was secured by using a nickel steel containing approximately 3.75 per cent of nickel. Steel containing approximately 25 per cent of nickel is nonmagnetic and has a very low resistance temperature coefficient. This property is occasionally of value where a nonmagnetic material of very high tensile strength is required. The high electrical resistance of nickel steel of this quality, together with its low temperature coefficient, makes it valuable for electrical resistance work where a small change in the resistance due to change in temperature is desirable. The main objection to using nickel steel for this purpose is the mechanical defects that are often found in wire that is drawn from this quality of nickel steel.

For rock drills and other rock-working machinery nickel steel is used in the manufacture of the forgings which are subjected to repeated and violent shocks. The nickel content of the steel used in these forgings is approximately 3 per cent, with about 0.40 per cent of carbon. The rock drills or bits are made for the most part of ordinary crucible cast steel which has been hardened and tempered. There is a field for investigation here in respect to the value of some of the special steels in the manufacture of rock-drill steels or bits.

A nickel-chrome steel is now being made which is used to some extent in the manufacture of tools.

Nickel steel in the form of wire has been used quite extensively and for many purposes—for wet mines, torpedo-defense netting, electric-lamp wire, umbrella wire, corset wire, etc.—where a noncorrosive wire is especially desired. When a low coefficient of expansion is desired—as in the manufacture of armored glass, in the mounting of lenses, mirrors, lever tubes, balances for clocks, weighing machines, etc.—nickel steel gives good satisfaction. For special springs, both in the form of wire and flats, a high carbon nickel steel has been introduced to a considerable extent. Nickel steel is also being used in the manufacture of dies and shoes for stamp mills, for cutlery, tableware, harness mountings, etc.

Nickel steels containing from 25 to 30 per cent nickel are used abroad to some considerable extent for boiler and condenser tubes and are now being introduced into this country. The striking characteristic of these steels is their resistance to corrosion either by fresh, salt, or acid waters, by heat, and by superheated steam. The first commercial manufacture of high nickel-steel tubes began in France in 1898, and was followed in Germany in 1899; but it was not until February, 1903, that these tubes were made in the United States. Since then, however, Mr. Albert Ladd Colby[a] states—

The difficulties of their manufacture have been so thoroughly overcome that the 30 per cent nickel steel, seamless, cold-drawn marine boiler tubes, now a commercial proposition, are made in practically the same number of operations and with but a slightly greater percentage of discard than customary in the manufacture of ordinary seamless tubes, and, furthermore, the finished 30 per cent nickel-steel tube will stand all the manipulating tests contained in the specifications of the Bureau of Steam Engineering, United States Navy Department, for the acceptance of the carbon-steel seamless cold-drawn marine boiler tubes now in use. In addition, the nickel-steel tubes have a much greater tensile strength.

Although the first cost of the nickel-steel tubes for marine boilers is considerably in excess of the carbon-steel tubes, yet, on account of the longer life of the nickel-steel tubes, they are in the end cheaper than the others. At the present time 30 per cent nickel-steel tubes cost from 35 cents to 40 cents per pound, as compared with 12 cents to 15 cents per pound for the corresponding mild carbon-steel tubes. Thus their initial cost, when used in the boilers of torpedo-boat destroyers, is 2.13 times as great as the other kind and 2.43 times as great when used in the boilers of battle ships, but the nickel-steel tubes will last two and one-third times longer than those made of the carbon steel, and when finally taken from the boilers they can be sold not only for the market price of steel-tubing scrap, but also at an additional price of 20 cents per pound for their nickel content. Thus it is seen that 30 per cent nickel-steel boiler tubes are really more economical to purchase than carbon-steel boiler tubes.

In addition to marine boilers, high nickel-steel tubes can be used to advantage for stationary boilers, automobile boilers, and locomotive safe ends. It is the higher elastic limit of the 30 per cent nickel-steel boiler tubing that will prevent the leaks which are constantly being formed where the mild carbon-steel tube is used. The leaks are due to the expansion of the flue sheets when heated, which compress the tubes at the points where they pass through the flue sheets and cause in the case of the mild carbon-steel tube a permanent deformation; this results in the leakage and necessitates the frequent expanding of the tubes. In the high nickel-steel tubes this difficulty is overcome

[a] Proc. 11th General Meeting Soc. Naval Arch. and Marine Eng., Nov. 19, 1903.

by their higher elastic limit. This deformation and the resulting leakage are especially true of locomotive boilers. For automobile tubular boilers a 23 to 25 per cent nickel-steel tubing is used, each coiled section being made from one long piece of nickel-steel tubing, which, by a special heat treatment, is enabled to withstand this bending without cracking.

Nickel-steel tubing containing 12 per cent of nickel has been used by the French since 1898 in the manufacture of axles, brake beams, and carriage transoms for field artillery wagons, and the desired result in the reduction of weight has been obtained without loss of strength and without stiffness of the wagons. A 5 per cent nickel-steel tubing has been used in the manufacture of bicycles since 1896.

Much work and experimenting have been done on nickel steel; yet, on account of the wide range in physical properties of steels which contain from 2 to 45 per cent of nickel and of the variations which occur in each grade with varying quantities of carbon and with the addition of small quantities of chromium, molybdenum, tungsten, etc., the further study of the alloys of nickel with iron is of great importance to the metallurgist who may be in search of a steel which will be adapted for certain particular purposes. One of the foremost men who has studied the ferro alloys and their application in the manufacture of steel is Mr. R. A. Hadfield, manager of the Hecla Works, Sheffield, England. The results of his investigations have been embodied in a series of very valuable publications.

COBALT STEEL.

Some experiments[a] have been made with cobalt in the manufacture of a ferrocobalt which was used in making a cobalt steel. The presence of cobalt in the steel considerably increased its elastic limit and its breaking load, but thus far no commercial use has been made of this steel. On account of its high price it is impossible for a cobalt steel to enter into competition with nickel steel, as the properties which cobalt gives to steel are not distinct enough to make it of more value than the corresponding nickel steel.

The main use of cobalt, which is in the form of the oxide, is in manufacturing pigments, the principal one being known as cobalt blue. As the demand for cobalt oxide is small, there could easily be an overproduction of this compound.

SOURCES OF SUPPLY.

There is still but little nickel or cobalt mined in the United States, and the chief sources of supply of these metals are the large mines in the Sudbury district, Canada, and the mines of New Caledonia, an

[a] Hadfield, R. A., Iron and Steel Metallurgist and Metallographist, January, 1904, p. 10.

island belonging to France, in the Pacific Ocean off the east coast of Australia.

An interesting occurrence of a cobalt-nickel ore has recently been discovered in Canada during the building of the Temiscaming and Northern Ontario Railroad. The deposits were found about 5 miles south of the village of Heileybury on the Ontario side of the northern part of Lake Temiscaming. They are about 90 miles northeast of the town of Sudbury, near which are situated the nickel mines referred to above. The ore of these new deposits is distinct from that of the Sudbury district, and consists principally of the minerals smalltite, niccolite, and safflorite.

The International Nickel Company, which controls the largest deposits of nickel ore at Sudbury, Ontario, Canada, has recently remodeled its entire plant at Copper Cliff and now has a most modern nickel-copper smelter. The ore which they are treating contains from 2 to 5 per cent of nickel and from 1½ to 8 per cent of copper, and is a nickeliferous pyrrhotite. The general composition of the ores from the various mines of the company is shown by the following analyses:

Analyses of nickel ore from mines of the International Nickel Company. ([a])

Constituent.	Cliff mine.	No. 2 mine.	Creighton mine.
Copper	8.05	2.23	1.69
Nickel	2.97	3.35	5.13
Iron	26.21	46.47	45.70
Silica	26.05	11.87	9.65
Sulphur	19.08	26.18	27.79
Total	82.36	90.10	89.96

[a] Chemist of Canadian Copper Company, Copper Cliff, Ontario, analyst.

This ore is crushed at the mine and roasted in heaps, where it remains for about one hundred days, during which time the sulphur is reduced to about 10 per cent. At the end of this time the ore is in fine shape for the blast furnace, being in large lumps and very porous and free from water. It is conveyed from these roast heaps to the top of the pocket trestle in dump cars, where it is dumped down through the bottom of the pockets into 2-ton side-dump-charge cars and hauled to the furnaces by electric locomotives. In dumping the ore into the furnaces care is taken to keep the bright spots covered with charges of ore. In charging the furnaces 10 per cent of coke is used, and during the operation the metal content is raised from 7 to 30 per cent. This could easily be increased to 40 or 50 per cent, but it seems more advantageous to produce a 30 per cent matte, adding enough green ore to the charges to keep the tenor down to that point. By keeping the proportion of metal in the matte down to 30 per cent, a higher per cent of iron is retained in the matte, with a correspondingly less quantity of oxidized iron for the slag, but, therefore, with higher percentage of silica in the slag. In order to obtain this reaction the proper adjustment of fuel and blast is an important governing factor. The composition of the ore is such that without any outside additions or flux a slag is obtained having a general composition as follows:

Composition of slag from nickel smelting.

Constituent.	Per cent.
Silica	29
Iron	41
Lime and magnesia	10
Total	80

Occasionally it is necessary to add a little pure quartz in order to keep the silica up to 29 per cent, which has been found to be the lowest safe economical quantity of silica to run.

As the slag and matte run from the furnaces into the settlers the specific gravity of the slag is 3.78 and that of the 30 per cent matte is 5.20, and consequently they can be separated very readily.

The matte is tapped from the settler as needed, poured into a converter which has a siliceous lining, and blown. By this operation the sulphur goes off as sulphur dioxide, freeing the iron first, which unites with the silica of the lining and forms a slag. The danger point approaches with the diminishing quantity of iron; for when the iron is exhausted, the nickel will be the next metal to go into the slag. The operation is therefore stopped while there is still from 1 to 2 per cent of iron in the matte and the tenor is 80 per cent nickel and copper, called "white metal." The matte formerly shipped from the Copper Cliffs smelter contained from 73 to 75 per cent metal. The new plant is producing an 80 per cent or better matte. It was for this purpose that the new plant was designed, namely, to reduce the cost of handling and smelting with the production of a higher grade matte rather than to increase the production itself.

PRODUCTION.

The main supply of nickel and cobalt produced in the United States is from Mine La Motte, Mo., where it is obtained as a by-product in lead smelting by the Mine La Motte Lead and Smelting Company. The production amounted in 1903 to 661 tons of matte. The nickel content of this matte was 114,200 pounds, valued at $45,900, and the cobalt oxide content was 120,000 pounds, valued at $228,000. This is an increase in production of 108,452 pounds of nickel and of 116,270 pounds of cobalt oxide, as compared with 5,748 pounds of nickel and 3,730 pounds of cobalt oxide produced in 1902.

The production of nickel and cobalt ores in the United States during 1903 amounted to 135 tons, which were obtained from Oregon and Idaho during development work, and only 21 tons, valued at $1,900, were shipped.

In the following table are shown the production and value of nickel obtained from domestic ores from 1887 to 1903, inclusive:

Production of nickel from domestic ores in the United States, 1887–1903.

[Pounds.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1887	205,566	$133,200	1896	17,170	$4,464
1888	204,328	127,632	1897	23,707	7,823
1889	252,663	151,598	1898	11,145	3,956
1890	223,488	134,093	1899	22,541	8,566
1891	118,498	71,099	1900	9,715	3,886
1892	92,252	50,739	1901	6,700	3,551
1893	49,399	22,197	1902	5,748	2,701
1894	9,616	3,269	1903	114,200	45,900
1895	10,302	3,091			

In the table below is given the production of cobalt oxide in United States from domestic ores from 1869 to 1903, inclusive:

Production of cobalt oxide in the United States, 1869–1903.

[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	7,828	1889	13,955	1901	13,360
1878	4,508	1890	6,788	1902	3,730
1879	4,876	1891	7,200	1903	120,000
1880	7,251	1892	7,869		

[a] Including cobalt oxide in ore and matte.

CANADIAN PRODUCTION.

As nearly all of the nickel used in the United States is obtained from Canada, with only a small amount from New Caledonia, a table is given below showing the quantity of nickel ore mined and smelted in Canada, together with the quantity of matte obtained from it, for the years 1896 to 1903, inclusive:

Production of nickel in Canada, 1896–1903. ([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	98,155	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
1903	136,633	209,030	13,832	12,505,510

[a] As reported by the director of the bureau of mines, Ontario, Canada.

IMPORTS.

In the following tables are given the quantity and value of cobalt oxide and nickel imported into the United States, the larger part of the nickel being obtained from the Canadian mines. The quantity of nickel matte, etc., imported into the United States in 1903 was over 2,000,000 pounds less than in 1902, but with an increase of over $50,000 in value. As compared with the imports of 1901, this is a decrease of over 81,000,000 pounds in quantity but of only $355,000 in value. This decrease in quantity and relative increase in value is due to the high-grade matte that was shipped from the smelters to the refiners located in the United States.

Cobalt oxide imported and entered for consumption in the United States, 1868–1903.

Year ending—	Oxide.		Year ending—	Oxide.	
	Quantity.	Value.		Quantity.	Value.
June 30—	*Pounds.*		Dec. 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	8,698	1896	27,180	36,212
1879	7,581	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	68,817
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	1903	73,350	145,264

Nickel imported and entered for consumption in the United States, 1868–1903.

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	14,508	185,744	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
December 31—					
1886			277,112	141,546	[b] 141,546
1887			439,037	205,232	[c] 205,232
1888			316,895	138,290	[d] 138,290
1889			367,288	156,331	[e] 156,331
1890	[f] 566,571	260,665	247,299	115,614	376,279
1891	355,455	172,476	[g] 10,245,200	148,687	321,163
1892			[h] 4,487,890	428,062	428,062
1893			[h] 12,427,986	386,740	386,740
1894			[h] 9,286,733	310,581	310,581
1895			[h] 20,355,749	629,910	629,910
1896			[h] 23,718,411	620,425	620,425
1897			[h] 27,821,232	781,483	781,483
1898			[h] 60,090,240	1,534,262	1,534,262
1899			[h] 44,479,841	1,216,253	1,216,253
1900			[i] 57,500,800	1,183,884	1,183,884
1901			[j] 117,864,337	[j] 1,849,620	1,849,620
1902			[k] 33,942,710	[k] 1,437,649	1,437,649
1903			[l] 36,217,985	[l] 1,498,889	1,498,889

[a] Including metallic nickel.
[b] Including $465 worth of manufactured nickel.
[c] Including $879 worth of manufactured nickel.
[d] Including $2,281 worth of manufactured nickel.
[e] Including $131 worth of manufactured nickel.
[f] Classified as nickel, nickel oxide, alloy of any kind in which nickel is the element or material of chief value.
[g] Classified as nickel and nickel matte.
[h] Includes all nickel imports except manufactures; nearly all of this is nickel in matte from Canada, containing about 20 per cent nickel.
[i] Ore and matte. In addition 455,188 pounds of nickel, nickel oxide, etc., were imported, valued at $139,786.
[j] 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.
[k] 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.
[l] Besides nickel ore and nickel matte, these figures include 521,345 pounds, valued at $170,670, of nickel, nickel oxide, alloy in which nickel is the material of chief value, and $37,284, the value of manufactures of nickel not specially provided for.

EXPORTS.

As a very large part of the Canadian production of nickel matte is refined in this country, it would naturally be expected that there would be considerable nickel exported from the United States, and in 1903 this amounted to 2,414,499 pounds, valued at $703,550. The quantity and value of nickel exported in the United States since 1894 are given in the following table:

Exports of nickel oxide and matte from the United States, 1894–1903.

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	1903	2,414,499	703,550

[a] Latter six months; not separately classified prior to July 1, 1894.

FOREIGN PRODUCTION.

There is given in the following table the production of nickel in Canada, France, and Germany from 1889 to 1903 as far as the statistics could be obtained. 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 imports represent nickel matte, ore, etc., and not the metallic nickel, as is given in the table below.

Production of nickel in Canada, France, and Germany, 1889–1903.

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	2,076,851	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	9,189,047	4,594,523	1,800	1,440,000	1,659	1,184,263
1902	10,693,410	5,025,903	1,600	1,080,800	1,605	1,122,271
1903	12,505,510	5,002,204	....	....	....	....

CHROMIUM.

The only mineral that is being mined as an ore of chromium is chromite, whose chemical composition is represented by the formula $FeCr_2O_4$. At the present time nearly all of this mineral that is used in the United States is imported, being obtained from Asiatic Turkey, New Caledonia, and Canada. The only State in the United States that is now producing any chromite is California. The North Carolina deposits, located near Burnsville, Yancey County, have recently been sold and are now being thoroughly developed. These deposits were formerly 20 miles from railroad transportation, which was prohibitory to their being worked; now, however, the railroad passes within 3 miles of them.

CHROMIUM STEEL.

The largest use of chromium is in the manufacture of a ferrochromium alloy which is used in the manufacture of chrome steel. In the manufacture of armor plate ferrochrome plays a very important part, and, although it is sometimes used alone for giving hardness and toughness to the armor plate, it is more commonly used in combination with nickel, making a nickel-chromium steel armor plate. Other uses of chrome steel are in connection with five-ply welded chrome steel and iron plates for burglar-proof vaults, safes, etc., and for castings that are to be subjected to unusually severe service, such as battery shoes and dies, wearing plates for stone crushers, etc. A higher chromium steel which is free from manganese will resist oxidation and the corrosive action of steam, fire, water, etc., to a considerable extent, and these properties make it valuable in the manufacture of boiler tubes. Chromium steel is also used to some extent as a tool steel, but for high-speed tools it is being largely replaced by tungsten steel, which seems to be especially adapted to this purpose.

In the manufacture of chromium steel it has been found to be much more advantageous to use the ferrochromium alloy instead of the pure chromium metal, for the main reason that it is difficult to introduce chromium into a steel bath by using the metal, especially if it is free from carbon, as the pieces of chromium melt with great difficulty, and they are apt to float on the bath. On the other hand, a ferrochromium alloy with low carbon is very fusible and becomes evenly distributed through the steel bath, thus making a purer and more homogeneous chromium steel.

Ferrochromium is made in an electric furnace and is produced directly from the ore. In the United States the company producing the largest quantity of ferrochromium is the Wilson Aluminum Company, whose electric furnaces are located at Kanawha Falls, W. Va. Besides the manufacture of ferrochromium this company also makes ferrotungsten, ferromolybdenum, ferrosilicon, ferrovanadium, and ferrotitanium. The company obtains its chief supply of chrome ores from the Daghardi mines, in Asia Minor, and the Thiebargi mines, in New Caledonia.

Typical analyses of the Turkish and New Caledonian ores which are imported by the Wilson Aluminum Company are as follows:

Analyses of chromite ores. (a)

Constituent.	Turkish ore.	New Caledonian ore.
	Per cent.	*Per cent.*
Chromic oxide	50.30	54.50
Ferrous oxide	15.50	17.70
Alumina	13.10	11.00
Silica	7.00	3.10
Lime	14.10	1.60
Magnesia		8.00
Total	100.00	95.90

a Chemist of Wilson Aluminum Company, analyst.

There are two grades of ferrochromium made from these ores, which are known as crystalline and solid. The crystalline ferrochromium can be broken into very small pieces, and is often preferred by those who use it in small quantities and under comparatively low temperatures. The following tables of analyses illustrate the chemical composition of crystalline and solid ferrochromium:

Analyses of crystalline ferrochromium alloys. (a)

Constituent.	1.	2.
	Per cent.	*Per cent.*
Chromium	67.000	68.000
Iron	24.380	20.000
Silicon	.490	1.250
Sulphur	.007	.199
Phosphorus	.005	.007
Carbon	8.050	10.500
Total	99.932	99.956

a Chemist of Wilson Aluminum Company, analyst.

Analyses of solid ferrochromium alloy. (a)

Constituent.	1.	2.	3.
	Per cent.	*Per cent.*	*Per cent.*
Chromium	71.980	70.070	69.880
Iron	22.610	22.770	24.010
Silicon	.550	.430	.540
Sulphur	.061	.089	.078
Phosphorus	.008	.009	.008
Carbon	4.789	6.601	5.464
Total	99.998	99.969	99.980

a Chemist of Wilson Aluminum Company, analyst.

Ferrochromium has also been made by the Wilson Aluminum Company from the chromium ores from the Black Lake district, Quebec Province, Canada.

The analysis of the ore used was as follows:

Partial analysis of chromium ore from Black Lake district, Quebec, Canada. (a)

Constituent.	Per cent.
Chromic oxide	50.00
Ferrous oxide	19.50
Silica	4.90
Magnesia	11.00
Total	85.40

a Chemist of Wilson Aluminum Company, analyst.

From this ore there was obtained a ferro-chromium alloy having the following chemical composition:

Analysis of ferrochromium alloy obtained from Black Lake ore. (a)

Constituent.	Per cent.
Chromium	66.00
Iron	28.60
Silicon	.50
Carbon	4.90
Total	100.00

a Chemist of Wilson Aluminum Company, analyst.

The Wilson Aluminum Company has been supplying the ferrochromium used by the Bethlehem and the Carnegie steel companies for the armor plates, which these companies have manufactured for the Governments of the United States, Russia, and Japan.

In connection with the chemical composition of the ferrochromium alloy it may be of interest to give analyses of some of the ferrochromiums made by the George G. Blackwell, Sons & Co., of Liverpool, England. This company makes two distinct grades of ferrochromium, one of which is very low in carbon. The two following analyses, which were made by Dr. George Tate, of London, represent their standard ferrochromium.

Analyses of Blackwell ferrochromium.[a]

Constituent.	1.	2.
	Per cent.	*Per cent.*
Chromium	64.050	63.600
Iron	25.450	24.190
Silicon	1.880	1.500
Sulphur	.046	.005
Phosphorus	.025	.030
Carbon	8.550	9.830
Manganese	Trace.	.216
Undetermined		.621
Total	100.001	100.262

This company is also making what it calls a refined ferrochromium which is low in carbon and contains from 62 to 68 per cent of chromium; it is of two qualities, known as No. 1 and No. 2. The No. 2 quality contains a higher percentage of carbon than the No. 1, but it is still considerably lower in carbon than the ordinary ferrochromium, and can be sold at a cheaper rate than the No. 1. The general composition of these two ferrochromiums is represented by the analyses given below:

Partial analyses of Blackwell ferrochromiums.[a]

Constituent.	1.	2.
	Per cent.	*Per cent.*
Chromium	62.00 to 68.00	62.000 to 68.000
Carbon	.50 to 1.00	1.500 to 2.500
Silicon	.20 to .25	.200 to .300
Sulphur	.05 to .08	.080 to .150
Phosphorus	.01 to .05	.015 to .020
Magnesia	Trace.	Trace.
Total	62.76 to 69.38	63.795 to 70.970

Another ferrochrome alloy that is manufactured by the George G. Blackwell, Sons & Co., contains 74.5 per cent of chromium, 23.8 per cent of iron, 1 to 3 per cent of carbon, and 0.2 of silicon. This ferrochrome alloy has been made especially for use in the manufacture of chromium steel to be used in the manufacture of tools.

The percentage of chromium that is used in the chromium steels varies from 2.5 to about 5 per cent and the carbon from 0.8 to 2 per cent. As a chromium steel free from carbon does not harden, it would seem that a certain per cent of carbon is essential in order for the chromium to give the desired hardening action to the steel, which is very energetic when this small amount of carbon is present. It may be that the chromium causes the formation of a very hard iron carbide, or double carbides of iron and chromium. The hardness, toughness, and stiffness which are obtained in chromium steel are very essential

[a] Chemist of George G. Blackwell Sons & Co., analyst.

qualities, and are what make this steel especially beneficial for the manufacture of armor-piercing projectiles as well as of armor plate. For projectiles chromium steel has thus far given better satisfaction than any of the other special steels, and is practically the only steel that is used for this purpose. The value of chromium steel for this purpose is well brought out by Mr. R. A. Hadfield, manager of the Hecla Works, Sheffield, England, who states[a] that a 6-inch armor-piercing shot made by his firm was fired at a 9-inch compound plate, which it perforated unbroken. It was then fired again from the same gun and perforated a second plate of the same thickness, the shot still remaining unbroken.

OTHER USES OF CHROMITE.

Chromite is used quite extensively in the manufacture of chromium salts for pigments, and also to some extent in the manufacture of chrome bricks. These chrome bricks are used in smelting furnaces and open-hearth steel furnaces, and in the lower parts of soaking pits. In the construction of steel furnaces and smelters a chromium brick, being a neutral one, is used to separate the magnesia brick, which is a base, and the silica brick, which is acid. They are also used in the back part of the uptakes of the port ends in order to neutralize or prevent the eating action of the slag that comes over in the form of cinders. In the soaking pits their use is to counteract the eating effect of the scales that drop off the steel billets when they are heated. These bricks are manufactured by the Harbison-Walker Refractories Company, of Pittsburg, Pa., which makes them in all shapes desired.

PRODUCTION.

There is only one State—California—that produced any chromite during 1903, the quantity being 150 long tons, valued at $2,250, as against the production of 315 long tons, valued at $4,567, in 1902. This is a decrease of 165 tons in quantity and of $2,317 in value. In the following table is given the production of chromite in the United States since 1885:

Production of chromite, 1885–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1885	2,700	$40,000	1895	1,740	$16,795
1886	2,000	30,000	1896	786	6,667
1887	3,000	40,000	1897	....	....
1888	1,500	20,000	1898	....	....
1889	2,000	30,000	1899	....	....
1890	3,599	53,985	1900	140	1,400
1891	1,372	20,580	1901	368	5,790
1892	1,500	25,000	1902	315	4,567
1893	1,450	21,750	1903	150	2,250
1894	3,680	53,231			

[a] The Iron and Steel Metallurgist and Metallographist, January, 1904, p. 8.

IMPORTS.

The largest quantity of chrômite used in the United States is imported from Turkey, with smaller quantities from New Caledonia and Canada. Besides the chrome ore, there is also considerable chromate and bichromate of potash and chromic acid imported. Prior to 1884 there was little or no chromite imported, and the supply was obtained from Maryland and Pennsylvania. Since then, however, the importation of this ore has been steadily increasing. In the following table are shown the quantity and value of chrome ore and 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, 1867–1903.

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	127,338	....	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	3,506,740	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	1,965,809	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	56,897	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	83,134	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
1903	[a] 227,215	32,174	....	....	22,932	292,025	324,199

[a] Includes a small amount of chromic acid, not reported separately.

As is seen from this table, there was a large falling off in the quantity of chrome ore imported during 1903 as compared with 1902.

CANADIAN PRODUCTION.

The Canadian chromite deposits which are located in the vicinity of Black Lake and Colraine, Quebec Province, again became producers of this mineral in 1902, when the production amounted to 900 short tons, valued at $13,000, which in 1903 had increased to 3,383 tons, valued at $33,830. Most of this chromite was shipped to the United States.

TUNGSTEN.

Owing to the many inquiries that have been made for tungsten ores there has been an unusual amount of prospecting for them during 1903, with the result that many new localities have been discovered where these ores are found in greater or less quantity. Thus far, however, none of the new deposits have been developed sufficiently to determine the actual amount of ore that they contain. It was found impossible during the latter part of 1903 to fill orders for 100 tons per month of tungsten ore, and none of the producers of these ores were willing to contract to furnish this quantity at the price quoted of $180 to $200 per ton for a 60 to 65 per cent ore.

The principal mining for tungsten ores during 1903 was in Colorado and in the vicinity of Dragoon, Ariz. These latter deposits have been developed quite extensively by the Primos Chemical Company. The ore consists principally of hübnerite, with very small quantities of scheelite, and is easily concentrated, giving a product containing from 70 to 72 per cent of tungstic acid. The deepest work done on the property is 100 feet below the surface, and to this depth the ledges continue firm. Nearly all of the ore that has been taken out during the development work has been concentrated and used in the manufacture of ferrotungsten or of metallic tungsten. An average analysis of the concentrates from this ore is as follows:

Analysis of tungsten ore from Dragoon, Ariz.[a]

Constituent.	Per cent.
Tungstic acid	70.22
Silica	.30
Iron	1.90
Manganese	19.82
Lime	4.87
Magnesia	3.40
Total	100.51

[a] Primos Chemical Company, Primos, Pa.

The tungsten property, located near Osceola, White Pine County, Nev., was bonded during 1903, and development work was carried on to determine what production per month could be made from these deposits.

TUNGSTEN STEEL.

The demand for tungsten ores for use in the manufacture of ferrotungsten to be used in the manufacture of tungsten steel continues to increase, especially from abroad. Tungsten steel is used to some extent more generally abroad than in the United States, in the manufacture of armor plate and armor-piercing projectiles. For this purpose it is used in combination either with nickel or chromium, or with both of these metals.

The use for which tungsten steel seems to be best adapted is in the manufacture of high-speed tools and magnet steels. The property that tungsten imparts to the steel is that of hardening in the air after forging and without recourse to the usual methods of tempering, such as immersion in oil, water, or some special solution. For high-speed tools tungsten steel is especially adapted, as it retains its hardness and cutting edge even at the temperature developed in the use of these high-speed tools. The value of tungsten steel for permanent magnets is on account of it retaining comparatively strong magnetism and of the permanence of this magnetism in the steel. This property makes the tungsten steel particularly desirable in instrument work where the calibration of the instrument depends upon the permanence of the magnet used. For compass needles tungsten steel has been used by W. and L. E. Gurley with entire satisfaction.

Ferrotungsten is manufactured like ferrochrome by reducing the ores directly in an electric furnace. These alloys vary in their tungsten content from 30 to 80 per cent, according to the purpose for which the ferrotungsten is to be used. The composition of some of these ferrotungstens on the market are shown in the table of analyses below, No. 1 being a ferrotungsten manufactured by the Wilson Aluminum Company, of Kanawha Falls, W. Va., and No. 2, by George G. Blackwell, Sons & Co., of Liverpool, England.

Analyses of ferrotungsten.

Constituent.	1.	2.
	Per cent.	*Per cent.*
Tungsten	83.90	78.80
Iron	12.10	10.90
Carbon	3.30	3.20
Silicon	.50	1.87
Phosphorus	....	.10
Sulphur	....	.11
Total	99.80	94.98

The Blackwell Company also manufactures a tungsten-nickel alloy containing 73 to 75 per cent tungsten, 23 to 25 per cent nickel, 2 to 2.5 per cent iron, 0.75 to 1 per cent carbon, and 0.25 to 0.50 per cent silicon.

The quantity of tungsten that is used in tungsten steel varies from 3 to 10 per cent, and is occasionally as much as 24 per cent; but the percentage is usually nearer the lower figure. The carbon varies from 0.4 to 2 per cent. The Taylor-White tungsten-steel contains from 3 to 4 per cent of chromium, and is made in two grades, one for cutting soft steel and gray cast iron and the other for cutting hard steel. The tungsten content in both grades remains constant, but there is 3 per cent of chromium in the grade use for cutting soft steel and 4 per cent in that used for cutting hard steel. The following analysis represents the composition of these two grades of tungsten steel:

Composition of the grades of Taylor-White tungsten steel.

Constituent.	For cutting hard steel.	For cutting soft st el.
	Per cent.	*Per cent.*
Tungsten	8.50	8.50
Chromium	4.00	3.00
Carbon	1.25	0.75 to 1.00
Total	13.75	12.25 to 12.50

Tools made from these steels retain their cutting power even when the friction is so great that the edge of the tool becomes red-hot.

Prof. Henry M. Howe,[a] gives the composition of many of the self-hardening tungsten steels as lying within the following limits:

General composition of tungsten steel.

Constituent.	Per cent.
Tungsten	3.44 to 24.00
Chromium	.00 to 6.00
Carbon	.40 to 2.19
Silicon	.21 to 3.00
Total	4.05 to 35.19

There is considerable variation in the opinion of the various steel makers as to the value of tungsten in the manufacture of armor plate. As is well known, it is used to some extent at the present time by the European steel manufacturers for armor plate. In combination with nickel and chromium, it will undoubtedly give results equal to the nickel and chromium steels. Some of the manufacturers go as far as to say that a tungsten steel will make better armor plate than either

[a] Iron, Steel, and Other Alloys, 1903, p. 324.

nickel or chromium steel. Two of the main objections to the use of tungsten steel at the present time for this purpose are the scarcity of the supply and its higher cost.

PRODUCTION.

The production of crude tungsten ores in the United States during 1903 was 2,451 short tons.

Most of this ore was concentrated, and there were sold 292 short tons of concentrates, valued at $43,639, which is approximately $149 per ton. The prices varied from $110 to $250 per ton, according to the percentage of tungstic acid. This production was obtained from Colorado, Arizona, and Connecticut, given in the order of the importance of their output.

IMPORTS.

During the last two years there have been imported into the United States small quantities of tungsten ores and tungsten alloys. In 1903 the imports of ferro-tungsten-chrome alloy amounted to $18,136 in value, and in 1902 the value of the imports of tungsten ore and alloys was $7,046. Tungsten ores are admitted free of duty.

MOLYBDENUM.

The use of molybdenum steel continues to increase, and hence there is an increasing demand for the ores of this metal. The main use of ferromolybdenum is in the manufacture of a tool steel. The properties which molybdenum gives to steel are very similar to those given by tungsten, the main difference being that it requires a smaller quantity of molybdenum than of tungsten to obtain the same results. Ferromolybdenum is produced, like ferrotungsten, by reducing it from the ore in an electric furnace. There are now two molybdenum-nickel alloys being produced, one of which contains 75 per cent molybdenum and 25 per cent nickel, and the other 50 per cent molybdenum and 50 per cent nickel. Besides these constituents the alloy contains from 2 to 2.5 per cent iron, 1 to 1.5 per cent carbon, and 0.25 to 0.50 per cent silicon. The molybdenum steel which is made from these alloys is recommended for large cranks and propeller-shaft forgings, for large guns, rifle barrels, and for wiring and for boiler plates. The molybdenum increases the elongation of steel very considerably, and for wire drawing such an increase at a comparatively small cost is important.

There are many localities where molybdenum ores occur in quantity, but, owing to the uncertainty of the value of the concentrates, many of these properties still remain undeveloped. The year 1903, however, saw a great deal of prospecting for these ores, with the result that a number of new localities were discovered that give promise of developing into large deposits. Wulfenite was discovered on the property of the Troy-Manhattan Copper Company, at Troy, Ariz., and after the deposit was opened and developed the company erected a 40-ton concentrating mill and is now preparing the concentrates for market.

The deposit of molybdenum at Cooper, Me., has been developed very extensively by the American Molybdenum Company, and during the last year the company has erected a cleaning and concentrating plant for treating this ore. Other properties that were partly developed in 1903 are as follows:

One mile east of Climax, Summit County, Colo., on the north side of Bartlett Mountain, a deposit of moybdenum has been developed by Mr. H. Leal, of Cresco, Nebr. Mr. T. L. Quigley, of Ophir, Mont., has located a deposit of molybdenum about 2 miles east of Orphir, in Carpenters Gulch. Another deposit near Dillon, Mont., has been developed by Mr. L. D. Graeter. The molybdenum mines of the Crown Point Mining Company, in Chelan County, Wash., produced some very large clusters of crystals of molybdenum during 1903, which were sold. One large crystal, or cluster of crystals, weighed 300 pounds.

At the Mammoth mine, Mammoth, Ariz., work was continued by Mr. Charles Eudall, of Tucson, in separating the wulfenite from the old tailings of this mine.

PRODUCTION.

The production of molybdenite ore during 1903 amounted to about 6,200 tons of crude ore, very little of which was treated and most of which is still lying on the dumps. Most of the wulfenite ore that was mined was concentrated, and these concentrates, together with the concentrates of the molybdenite, amounted to about 795 short tons, valued at $60,865. There is still wide variation reported in the prices of molybdenite ore, which range from $100 to $3,000 per ton. It is more than probable that the actual value of molybdenum concentrates at New York will be in the neighborhood of $200 per ton.

URANIUM AND VANADIUM.

VANADIUM STEEL.

On account of the extremely high price and scarcity of vanadium ores, the metal has thus far been employed very little in the manufacture of ferrovanadium for use in the production of vanadium steel. It is claimed by many that the beneficial properties imparted to steel by vanadium exceed those of any of the other steel-hardening metals. These are exaggerated statements, but it may be found that smaller quantities of vanadium will give in some cases the same results that are obtained by comparatively large quantities of the other metals. One property claimed for vanadium steel is that it acquires its maximum of hardness not by sudden cooling, but by annealing at a temperature of from 700° to 800° C. This property would be particularly advantageous for high-speed tool steel and for points of projectiles. There is, however, at the present time little or no vanadium steel on the market and no special production of ferrovanadium alloys. Since the discovery of the deposits of vanadium in Colorado and Utah they have been thoroughly developed, largely through the efforts of Mr. A. B. Frenzel, of Denver, Colo. He has also made experiments in the reduction of these ores, and now claims that a process has been perfected by which vanadium can be obtained at such prices that the ferrovanadium alloy can be manufactured so as to enter into competition with the other ferro alloys. The main source of supply of vanadium is Montrose County, Colo. These ores also contain more or less uranium and are mined for both metals.

URANIUM.

Experiments have been made with ferrouranium as to the value of the qualities that it gives to steel. Although it increases the stiffness and the toughness of steel to a considerable degree, these qualities are not distinct enough from the like qualities imparted to steel by other metals to warrant the use of ferrouranium for this purpose when its much higher cost is considered. The principal use of this compound is as a pigment in the manufacture of porcelain and glass.

PRODUCTION.

During 1903 there was considerable development work done upon uranium and vanadium deposits, which resulted in the production of 432 short tons of crude ore. Of this amount 30 tons of partially concentrated ore, valued at $5,625, were sold. In 1902 the production of uranium and vanadium minerals, as reported to the Survey, amounted to 3,810 tons, valued at $48,125. The 1903 production consists principally of the mineral carnotite, with a small amount of uranium.

IMPORTS.

Nearly all of the uranium and vanadium ores mined in the United States are exported. On the other hand, there is imported each year a considerable quantity of uranium and vanadium salts, which in 1903 were valued at $13,498, as against imports to the value of $12,491 in 1902.

TITANIUM.

The actual commercial value of titanium as a steel-hardening metal has not been thoroughly demonstrated. Experiments have shown that from 0.5 to 3 per cent of titanium increases the transverse strength and the tensile strength of steel to a very considerable degree.

Until the development of the electric furnace it was practically impossible to produce either titanium or an alloy of iron and titanium, but since the introduction of this furnace ferrotitanium can be produced directly from the ores. The fusing point of ferrotitanium is materially affected by its titanium content, and it is impracticable to fuse an alloy containing over 12 per cent of titanium in connection with cast iron in a cupola. Up to this point, however, no difficulty arises in fusing the alloy and incorporating the titanium in the iron. It is to the manufacture of a special cast iron that ferrotitanium seems to be especially adapted. The titanium in the iron gives greater density to the metal, greatly increases its transverse strength, and gives a harder chill or wearing quality to a wheel made from such an iron. For the manufacture of car wheels it would seem that the titanium iron would be especially useful.

A ferrotitanium has been manufactured by the Wilson Aluminum Company from a titanic iron ore from Caldwell County, N. C., which has the following composition:

Analysis of North Carolina titanic iron ore.

Constituent.	Per cent.
Titanium oxide	42.00
Ferrous oxide	38.00
Alumina	11.50
Silica	7.50
Total	99.00

This company has also made ferrotitanium from rutile concentrates mined in Nelson County, Va., and containing from 95 to 99 per cent of titanium oxide.

PLATINUM.

PRODUCTION.

The center of interest in platinum mining in the United States has shifted from Shasta and Trinity counties, Cal., to southern Oregon, where, in the neighborhood of Grants Pass and Kerby, considerable platinum and iridosmium are found in the placer gold. In collecting this material another heavy mineral has proved commercially profitable—that is, the natural alloy of iron and nickel called josephinite, which is found associated with the platinum and gold. The production of platinum increased slightly from the year 1902. The quantity of pure platinum contained in the platinum sand amounted to 110 ounces of refined metal, worth $2,080.

In addition to the above supplies of platinum sand, it is interesting to note that the platinum contained in the copper ores of the Rambler mine, Wyoming, has come definitely on the market, being obtained in the form of slimes in the treatment of the copper ore and matte from this mine. Detailed descriptions of this property were given in the preceding report of this series.

The following table shows the production of platinum in the United States since 1880:

Production of crude platinum in the United States, 1880–1900, and of refined metal from domestic ores in 1901–1903.

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	1903	110	[b]2,080

[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.

[b] Not including $6,000 worth of platinum reported as contained in slimes from copper ore from the Rambler mine, Wyoming.

IMPORTS.

The imports of platinum during 1903 were valued at $2,055,933, distributed as follows: Unmanufactured, 1,426 pounds ($328,103); ingots, bars, sheets, and wire, 6,308 pounds ($1,591,941); vases, retorts, and other apparatus, vessels and parts thereof for chemical uses, $128,890; manufactures of, not specially provided for, $6,999. The imports 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.

PRICE.

The price for pure platinum in wholesale quantities at New York continued during the whole of 1903, as during the last seven months of 1902, at $19 per ounce.

LITHIUM.

By Joseph Hyde Pratt.

SOURCES OF SUPPLY.

The only localities where lithium materials were produced in 1903 were at Pala, San Diego County, Cal., and at the Etta and Bob Ingersoll mines in the Black Hills, S. Dak. There are three different minerals that are mined at these localities for their lithium contents, lepidolite and spodumene, both lithium silicates, and amblygonite, a lithium phosphate. Of these three, the latter contains the highest percentage of lithia. For comparison, analyses of these three minerals are here given, the first two of amblygonite and lepidolite from Pala, Cal., and the third and fourth of spodumene from Goshen, Mass., and Branchville, Conn.

Analyses of amblygonite and lepidolite from Pala, San Diego County, Cal., 1902.

Constituent.	Amblygonite.[a]	Lepidolite.[a]
	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	(b)	16.16
Soda	(b)	.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] Rudolph L. Seldner, Brooklyn, N. Y., analyst. [b] Small amount.

Analyses of spodumene.

Constituent.	Spodumene.	
	Goshen, Mass. [a]	Branchville, Conn. [b]
SiO_2	63.27	64.25
Al_2O_3	23.73	27.20
Fe_2O_3	....	....
FeO	1.17	.20
MgO	2.02	....
CaO	.11	....
MnO	.64	....
K_2O	1.45	Trace.
Na_2O	.99	.39
Li_2O	6.89	7.62
H_2O	.36	.24
F	....	....
Total	100.63	99.90
Specific gravity	3.19	3.193

[a] Annals New York Acad. Sci., vol. 1, 1879, p. 322.
[b] Am. Jour. Sci., 3d series, vol. 20, 1880, p. 259.

Amblygonite occurs in the same locality as the lepidolite at Pala, San Diego County, Cal., but the deposit of this mineral was only discovered in 1902. Since then it has been thoroughly developed and the American Lithia and Chemical Company of New York City reports that a lens of amblygonite 33 feet wide and exposed to a depth of 11 feet has been brought to view. It has been estimated that over 400 tons of this mineral are now exposed. The production of lithium minerals from this locality in 1903 was restricted on account of litigation.

Besides the Pala locality of lepidolite, two new localities have recently been discovered, one 7 miles east of Julian, San Diego County, Cal., which is being developed by Mr. F. F. Griffith, of Los Angeles, Cal., and the other near Banner, San Diego County, Cal., which was located by Mr. E. H. Davis, of Mesa Grande, Cal. The former locality also contains some amblygonite.

All of the spodumene is obtained from the mines in Custer and Pennington counties, Black Hills, S. Dak., and principally from the Etta mine.

The lithium minerals that are mined are all shipped to New York, where a part is exported and the remainder is reduced by chemical companies.

PRODUCTION.

In 1903 the quantity of lithium minerals produced in the United States amounted to 1,155 short tons, valued at $23,425 at the railroad. This is a decrease of 90 tons in quantity and of $2,325 in value, as compared with the production of 1,245 short tons, valued at $25,750, in 1902. In the early part of 1903 there was a small demand for the lithium minerals, but toward the close of the year there was more call for these minerals, and, if this demand continues, the production of 1904 should be considerably greater than that of 1903. A number of individuals who produced no lithium in 1903 began mining in 1904, owing to orders received from abroad. As the uses of lithia are limited, there could readily be an overproduction of the crude minerals; but if the cost of these could be reduced, so that they might be used in the manufacture of lithium carbonate or nitrate for red fire in pyrotechnics, there would be an increased demand for these lithium minerals.

IMPORTS.

It has been estimated that there are about 55,000 pounds of lithium salts used in the United States each year, of which usually about one-third are imported. In 1903 these imports amounted to 5,596 pounds, valued at $3,669.

In 1902 the imports were 5,530 pounds of lithium carbonate, valued at $8,038, and 15,686 pounds of other lithium salts, valued at $14,913.

ANTIMONY.

By Joseph Struthers.

INTRODUCTION.

The outlook for the production of metallic antimony from domestic antimony ores in the United States is very unpromising, since the smelting process for the extraction of the metal is complex and costly, and but few metallurgists are conversant with all the details necessary for successful treatment. Moreover, the large production of antimony ores and metal in foreign countries, together with the low rate of ocean freights, and the removal, in April, 1902, of the import tax on crude antimony (which, in reality, is partly refined antimony sulphide ore), leave no opportunity for competition by the domestic product.

There are many deposits of antimony minerals, chiefly the sulphide, in the Western States, but even prior to the removal of the import tax on crude antimony in 1902, the production of metal from domestic antimony ores has never reached any prominence, the largest quantity so produced in a year being 295 tons in a total of 4,000, or approximately 7.4 per cent of the total annual production from ores. These statistics are of the year 1895. There has been no commercial production of metallic antimony from domestic antimony ores since 1901, in which year 50 tons were made by the Chapman Smelting Company, of San Francisco, Cal. Small quantities of metal have been produced experimentally from time to time, but as they do not reach the market they are not included in the statistics of production. Prior to 1902 the Chapman Smelting Company smelted a relatively small quantity of domestic antimony ores, but due chiefly to the removal of the duty on crude antimony in April, 1902, these works have since made no output of antimony metal from domestic ores.

Although many deposits of antimony minerals are located in the Western States, the outlook for their development is very discouraging. The low rates of ocean freight from foreign countries, where the cost of mining is extremely cheap, permit the delivery of ores near the market at a cost so small that the western ores, being in regions where the costs of fuel and labor are high, can not be profitably smelted at the mines, nor can they be shipped to refineries on account of the high railroad freight rates, hence there is no competition against the foreign product. A large part of the supply of antimony in the United States is in the form of hard lead, obtained as a by-product in the smelting and refining of lead-silver ores, and this branch of the antimony industry will naturally develop concurrently with the advance in lead smelting.

The control of the production and trade of antimony in the United States continues in the hands of Messrs. Mathison & Co., of London, operating the smelting plant at Chelsea, Staten Island, New York, and affiliated with the Chapman Smelting Company, of San Francisco, Cal.

USES.

The chief use of antimony metal is in the manufacture of alloys of 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 of bismuth (from 0.5 to 2 per cent) to the lead-antimony alloy (type metal) causes it to expand at the moment of solidification and to yield 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 various proportions of antimony (the commercial product has an antimony content of from 16.5 to 27 per cent, and generally averages about 25 per cent); *britannia metal* and *pewter*, used extensively for tableware, the former being an alloy of tin with from 10 to 16 per cent of antimony and 3 per cent of 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 as a mordant in dyeing vegetable fiber; *antimony cinnabar*, a fiery red-colored pigment, consisting of antimony trisulphide with a small amount of antimony trioxide, used in oil painting; and *antimony pentasulphide*, used as a red pigment in vulcanizing and coloring rubber.

PRODUCTION.

There are four sources of supply of antimony in the United States, in the following order of importance:

1. Hard lead, or antimonial lead, obtained as a by-product in smelting both foreign and domestic lead-silver ores, which contain a small percentage of antimony.
2. Antimony regulus, or metal, from foreign countries.
3. Antimony ores (including the so-called "crude" antimony) from foreign countries.
4. Antimony ores from domestic deposits.

The quantity of hard lead (antimonial lead) produced in the United States during 1903, as a by-product in smelting impure lead-silver ores, amounted to 21,237,440 pounds, containing approximately 5,115,319 pounds of metallic antimony (equivalent to an average content of 24.1 per cent of antimony in the hard lead), as compared with 20,970,000 pounds of hard lead, containing 5,808,000 pounds of antimony metal, in 1902, an increase for the year 1903 of 267,440 pounds of hard lead, but a decrease of 692,681 pounds in the actual amount of antimony contained therein. The reason for this decrease in the total quantity of antimony was due to the fact that, in 1902, one concern produced hard lead averaging 25.5 per cent of antimony, while in 1903 its percentage dropped to from 16.5 to 17. The average antimony content of hard lead ranges from 16.5 to 27 per cent.

Hard lead is used largely in the manufacture of antifriction and other alloys, and this alloy is obviously an important source of antimony supply in the United States.

The net imports into the United States of foreign antimony, in the form of regulus or antimony metal, amounted during 1903 to 4,694,309 pounds, valued at $260,144, as compared with 5,388,739 pounds, valued at $333,601, in 1902, a decrease in quantity of 694,430 pounds, and in value of $73,457 for the year 1903.

Imported antimony ores contain from 35 to 65 per cent of antimony, and for all commercial purposes the average metal content may be taken as 52.5 per cent. Ores containing a low percentage of antimony are not of sufficient value to stand the cost of transportation, although sometimes they are mixed with higher-grade ores in order to have their metal content and value increased to an amount at which they can be shipped with profit. The smelting loss on the treatment of antimony sulphide ores for the production of the refined metal approximates 20 per cent of the metal content, so that the average extraction of metal from imported ores may be taken at 42 per cent. On this basis the quantity of metal derivable from the net imports of foreign ores during 1903 is 1,140,100 pounds, as compared with 1,314,000 pounds in 1902, showing a decrease of 173,900 pounds for the year 1903.

There was no antimony metal produced from domestic antimony ores in the United States during the years 1902 and 1903. The latest recorded production was in 1901, when 50 tons of metal was produced from this source at the works of the Chapman Smelting Company, San Francisco, Cal. As elsewhere mentioned in this report, the production of antimony metal from domestic ores in the United States has never attained any prominence when compared with the total consumption of antimony metal and alloys in the United States.

The aggregate quantity of antimony available as metal or alloy in the hard lead produced from foreign and domestic lead-silver ores and imported for consumption as regulus or antimony ores during the year 1903 amounted to 5,115,319 pounds, as compared with 5,808,000 pounds in 1902, showing a decrease of 692,681 pounds for the year 1903.

The annual production of metallic antimony in the United States derivable from foreign ores and contained in the hard lead produced from 1880 to 1903, 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, 1880–1903.

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] 408	82,752	2,639	539,902
1902	2,904	505,340	[d] 657	129,166	3,561	634,506
1903	2,558	445,092	[d] 570	103,341	3,128	548,433

[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, and in 1903, when the reported quantity averaged 24.1 per cent.
[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 1903, as reported by the Bureau of Statistics of the Department of Commerce and Labor. 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 overimportation of both ore and metal.

In 1903 the importation of antimony ore entered for consumption was 2,714,617 pounds, valued at $54,316. In 1902 the net importation of antimony ore was 3,129,069 pounds, valued at $62,968. The statistics of net importation for 1903, as compared with 1902, show a decrease in quantity of 414,452 pounds, and in value of $8,652.

The annual imports of antimony metal, or regulus, and crude antimony or ore, which have been entered for consumption in the United States during the period 1867 to 1903, inclusive, are given in the subjoined table:

Antimony and antimony ore imported and entered for consumption in the United States, 1867–1903.

Year ending—	Metal and regulus.		Crude antimony and ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	
June 30—	*Pounds.*		*Pounds.*		
1867	....	$63,919	....	....	$63,919
1868	1,033,336	88,822	....	....	88,822
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	1,963,306	237,536	....	3,031	240,567
1873	1,166,821	184,498	....	2,941	187,439
1874	1,253,814	148,409	....	203	148,612
1875	1,238,228	181,360	6,460	609	181,969
1876	946,809	119,441	8,821	700	120,141
1877	1,115,124	135,317	20,001	2,314	137,631
1878	1,256,624	130,950	20,851	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	281,360	6,489	156,924
1885	2,579,840	207,215	215,918	7,497	214,712
December 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	1,433,581	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	2,658,487	193,988	375,468	a 18,805	212,793
1895	3,499,901	223,968	668,610	14,718	238,686
1896	2,576,871	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
1903	4,694,309	260,144	2,714,617	54,316	314,460

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 was due to a peculiar condition of the freight rates from China, which 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. According to the report of one of the principal importers, there has been no radical change in the freight conditions during the year 1903.

CONSUMPTION.

The consumption of antimony in the United States from 1880 to 1903 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, and in 1903, when the reported average was 24.1 per cent.

Estimated consumption of antimony in the United States, 1880–1903.

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
1903	2,558	Nil.	570	2,347	5,475

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 1903, 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.

WORLD'S PRODUCTION.

The following table, showing the output and value of antimony metal of the world in 1901 and 1902, has been compiled from the official governmental reports of the respective countries:

World's production of antimony metal in 1901 and 1902.

Country.	1901.		1902.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
United States [a]	403	$61,820	657	$129,166
Austria	126	10,434	26	1,737
France [b]	1,969	240,000	1,901	207,475
Germany [c]	2,783	268,250	3,858	331,188
Hungary [d]	777	82,920	753	81,200
Italy	1,898	195,560	1,202	91,236
Japan	474	58,737	....	....
Servia	268	40,824	344	42,492
Total	8,698	958,585	8,741	884,494

[a] Does not include the antimony contained in hard lead.
[b] Includes product of Algeria.
[c] Includes quicksilver.
[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 10¼ cents per pound. The following tables 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 1895 to 1903, inclusive.

Prices of antimony at New York, 1895–1903, by months.

[Cents per pound.]

Month.	1895.			1896.			1897.		
	Cookson's.	Hallett's.	Japanese.	Cookson's.	Hallett's.	Japanese.	Cookson's.	Hallett's.	Japanese.
January	8⅛ to 8⅜	7⅛ to 7¼	....	8¼	7¼ to 7⅜	7	7¼ to 7⅜	6⅝ to 6⅞	6⅝ to 6⅞
February	8¼ to 8⅜	7⅛ to 7¼	....	8¼	7⅛	7	7¼ to 7⅜	6⅝ to 6⅞	6⅝ to 6⅞
March	8¼	7⅛ to 7¼	....	8¼	7⅛	7	7¼ to 7⅜	6⅞ to 7⅛	6⅞ to 7
April	7⅞ to 8⅛	7 to 7⅛	6⅞ to 7	8¼	7⅛	7	7¼ to 7⅜	7 to 7⅛	7 to 7⅛
May	7⅞ to 8	7	6⅞	8 to 8¼	7¼ to 7⅜	6⅞ to 7	7¼ to 7⅝	7 to 7¼	6⅞ to 7⅛
June	7⅞ to 8	7 to 7⅛	6⅞	8	7¼	6⅞ to 7	7¼ to 7⅜	6⅝ to 7	6⅝ to 6⅞
July	8 to 8⅛	7⅛ to 7¼	7	8	7¼	6⅞ to 7	7 to 7⅜	6⅞ to 7⅛	6⅞
August	8	7⅛	7	8	7¼	6⅞ to 7	7 to 8¼	7⅛ to 7¼	6⅞ to 7
September	8	7⅛	6⅞ to 7	8	7¼	6⅞ to 7	8 to 8¼	7¼ to 7⅜	7 to 7⅛
October	7⅝ to 8	7 to 7⅛	6⅞	7¼ to 7⅜	6⅛	6⅝	8 to 8⅛	7¼ to 7⅜	7 to 7⅛
November	7⅝ to 7⅞	7	6⅝ to 6⅞	7⅛ to 7⅜	6⅛ to 6⅜	6½ to 6⅝	8 to 8⅛	7¼ to 7⅜	7 to 7⅛
December	7⅝ to 7⅞	6⅞ to 7	6⅝ to 6⅞	7¼ to 7⅜	6⅛	6⅝	8 to 8¼	7¼ to 7⅜	7 to 7⅛

Month.	1898.			1899.			1900.	
	Cookson's.	Hallett's.	Japanese.	Cookson's.	Hallett's.	United States.	Cookson's.	Hallett's.
January	8 to 8¼	7⅛ to 7¼	7⅛ to 7¼	10 to 10⅛	9⅛ to 9⅜	9⅛	10⅛ to 11	9⅝ to 9⅞
February	8 to 8¼	7¼ to 7⅛	....	10¼ to 10⅝	9⅝ to 10¼	9⅛ to 9⅜	10⅛ to 11	9⅝ to 10
March	8 to 8⅛	7⅛ to 7⅜	....	11⅛ to 12	10⅛ to 10⅜	10¼ to 10⅜	10⅛ to 11	9⅝ to 10
April	8⅛ to 9	7⅜ to 8	....	11⅛ to 12	10⅛ to 10⅜	10¼ to 10⅜	11	9⅝
May	9¼ to 9½	8⅝ to 8⅞	8⅞	11⅛ to 12	10⅛ to 10⅜	10½ to 10⅝	11	9⅝
June	9¼ to 9⅜	8⅞ to 9	8⅞ to 9	11⅛	10⅛	10½	11	9⅝
July	9⅝ to 9¾	9	9	11⅛	10⅛	10½	10⅛ to 11	9⅝ to 9⅞
August	9⅝ to 9¾	9	9	11⅛	10⅛	10⅞ to 11	10⅛	9⅝
September	9⅝ to 9¾	9	9	11⅛	10⅛	10⅞ to 11	10⅛	9⅝
October	9⅝ to 9¾	9	9	11⅛	10⅛	10½	10⅛	9⅝
November	9⅝ to 9¾	9	8⅞ to 9	11¼ to 11⅜	10¼ to 10⅜	10 to 10⅛	10⅛	9⅝
December	9⅝ to 9¾	8⅞ to 9	8¾ to 8⅞	11¼ to 11⅜	10¼ to 10⅜	10 to 10¼	10⅛	9⅝

Month.	1901.			1902.			1903.		
	Cookson's.	Hallett's.	Others.	Cookson's.	Hallett's.	Others.	Cookson's.	Hallett's.	Others.
January	10¼ to 10⅜	9¼	8⅝ to 9	10	8 to 8¼	7¾ to 8	8¼ to 8⅜	7 to 7⅛	6⅝ to 6⅞
February	10¼	9¼	8¾ to 9	10	8 to 8⅛	7¾	8½ to 8⅝	7 to 7¼	6⅝ to 6⅞
March	10¼	8¼ to 9¼	8⅛ to 9	9¾ to 10	8 to 8⅛	7¾	8¼	6¾ to 7	6⅛ to 6⅝
April	10¼	8¾ to 9	8⅛ to 8¾	9¾ to 10	8 to 8⅛	7¾	8¼	6¾ to 6⅞	6⅛
May	10¼	8¾ to 9	8⅛ to 8¾	9¾ to 10	8 to 8¼	7¾ to 8	7⅛ to 8	6⅝ to 6⅞	6⅛
June	10¼	8¾	....	9¾ to 10	8 to 8¼	8	7⅛ to 8	6⅝ to 6⅞	6⅝ to 6⅛
July	10¼	8¾	....	9¾	8¼	8	7¼ to 7⅛	6⅝ to 6⅞	6¼ to 6⅜
August	10¼	8¼ to 8¾	8¼ to 8⅛	9⅝	8 to 8¼	7¾ to 8	7 to 7⅛	6⅝ to 6⅛	5⅞ to 6¼
September	10¼	8⅛ to 8¾	8¼ to 8⅜	9⅛ to 9⅜	7¾ to 8	7¼ to 7⅝	7 to 7¼	6¼ to 6⅝	5⅞ to 6¼
October	10¼	8⅝ to 8⅞	8 to 8¼	9 to 9⅜	7⅛ to 7¾	7¼ to 7⅛	7 to 7¼	6¼ to 6⅝	5⅞ to 6¼
November	10¼	8⅝	8 to 8¼	9 to 9⅛	7⅝ to 7⅞	7⅛ to 7½	6⅞ to 7¼	6¼ to 6⅝	5⅞ to 6¼
December	10¼	8¼ to 8⅝	8 to 8¼	9 to 9⅛	7⅛ to 7⅜	6⅞ to 7	6⅞ to 7¼	6¼ to 6⅝	5⅞ to 6¼

THE TREATMENT OF ANTIMONY ORES IN JAPAN.

Antimony metal has been produced from its ores in Japan for centuries. The chief mine is in the island of Shikoku, from which high-grade stibnite is obtained and shipped to Sanchobar on the coast, where it is smelted and refined to metal. The smelting operation is executed in a very simple manner. A clay crucible, having a small hole bored through its bottom, is placed upon a second one. The upper crucible is filled with powdered antimony ores (stibnite, antimony sulphide) and tightly closed with a clay cover; coal is then heaped around the upper crucible and ignited. The heat serves to melt the stibnite, which separates or liquates from the gangue of the ore and flows through the hole in the bottom of the upper crucible into the lower one, from which it is ladled into molds and cooled. The concentrated antimony sulphide thus obtained is subsequently reduced to metallic antimony, which is shipped in boxes to various markets.

PATENTS.

In France M. H. L. Herrenschmidt obtained a patent (No. 333340, June 24, 1903) to treat antimony sulphide ore in a blown converter. The process is carried out as follows: The hearth of the converter is first covered with a layer of wood, which is then lighted. As soon as it is well ignited a layer of coke is added, followed by a layer of antimony sulphide ore containing from 40 to 60 per cent of antimony. Above the ore charge is a final layer of coke, and of antimony oxysulphide produced as a by-product in a former smelting in the converter. Air is then blown through the tuyeres and in connection with the heat of the burning fuel it transforms the antimony sulphide into volatile oxysulphide, which passes off with the furnace gases, and is condensed and collected in a suitable receiver. During the smelting operation a certain proportion of metallic antimony is reduced and tapped off. The oxysulphide is subsequently distilled with a proper reducing agent, forming metallic antimony and a poor oxysulphide residue, which is returned to the converter as a part of a later charge.

Mr. T. Crisp Sanderson, of Chelsea, Staten Island, New York, has patented a method for the continuous smelting of antimony ores (United States patent No. 714040, November, 1902), for which is claimed advantages in fuel consumption, labor, volatilization losses, and other factors of cost. The method is briefly described as follows: A bath of ferrous sulphide is formed in the hearth of a reverberatory furnace, and after closing the chimney damper the charge of antimony ore is shoveled into the furnace and quickly rabbled into the molten ferrous sulphide. As soon as it has become thoroughly mixed, scrap iron sufficient to decompose the antimony sulphide is introduced, and the temperature of the furnace raised to the proper degree. The bath is then thoroughly rabbled and the iron decomposes the antimony sulphide, forming metallic antimony and ferrous sulphide. When the reaction is completed the metallic antimony is tapped from a sump in the furnace until iron sulphide appears; the tap hole is then closed and the slag which floats on the surface of the bath of iron sulphide is removed by skimming. Owing to the formation in the furnace of iron sulphide from the reaction between the scrap iron and the sulphur of the ore, a certain quantity must be removed in order to lower the bath to its original level. Before tapping off the excess of iron sulphide an additional quantity of scrap iron is sometimes added to the bath and rabbled, so that some of the antimony remaining in the slag will be reduced; any metallic antimony so formed, however, will contain too much iron, and it is therefore left in the furnace for the succeeding charge, which removes the iron from it. Oxidized antimony ores may be treated in a similar way, using iron or carbon, or both, for the reducing agent. The Sanderson continuous process has been in successful operation at Chelsea, Staten Island, N. Y., for a year or more.

ARSENIC.

By Joseph Struthers.

INTRODUCTION.

OCCURRENCE.

Arsenic ores and, to a lesser extent, metallic arsenic occur widely distributed in many countries, but in very few places are the deposits of sufficient extent to be of commercial value.

The most common mineral (mainly used for the manufacture of arsenic compounds) is arsenopyrite, the double sulphide of iron and arsenic (FeAsS), commonly called "mispickel" or "arsenical pyrites." Other important minerals are the two sulphides, realgar (As_2S_2) and orpiment (As_2S_3), and the two forms of the sesquioxide (As_2O_3), arsenolite and claudetite. Arsenic also occurs in combination with nickel and cobalt, both as a sulphide and as an arseno-sulphide, and, to a minor extent, as an impurity in several other metallic minerals.

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 aniline 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.

PRODUCTION IN THE UNITED STATES.

The production of arsenious oxide (technically known as "white arsenic," and sometimes "arsenic") in the United States during 1903 amounted to 611 short tons, valued at $36,691, as compared with 1,353 tons in 1902, and 300 tons in 1901, the last-named year being the date of the inception of the white arsenic industry in the United States. The entire domestic product has been made solely at the plant of the Puget Sound Reduction Company, Everett, Wash., and the large increase in the domestic production during 1902 promised success to the undertaking. Owing to various commercial reasons, however, the by-product plant was operated at its full capacity only during the first quarter of the year 1903. It was shut down from March 1 until September 1, 1903, when, at the latter time, the works came under the control of the American Smelting and Refining Company. During the last three months of the year the by-product plant was used only for roasting small quantities of arsenical lead ores, and no white arsenic was shipped to the market.

The arsenic ores treated at this plant consist mainly of arsenopyrite, containing on the average about 14 per cent of arsenic and 0.7 ounce of gold and 3 ounces of silver per ton. A part of the ore treated contained only 2 per cent of sulphur, the arsenic being present chiefly in an oxidized form.

The by-product plant for the condensation and collection of the white arsenic is quite simple in construction and efficient in operation. There is a long brick flue, 20 feet high, connecting the Wethey mechanical 6-hearth 60-ton roasting furnace with the dust chamber, which latter is 5 feet high, and covers an area of about 125 by 150 feet. This chamber is built of 4-inch brick walls, and is divided into four equal parts, so arranged that by the use of valves or dampers any one section can be cut out from the other, and the condensation may thus be carried on continuously.

The arsenical compounds in the ore are decomposed during the roasting, and are transformed chiefly into volatile arsenious oxide, which passes out with the waste gases of the furnace, and is subsequently condensed by their cooling and lessened velocity, and settles on the floor of the dust chamber, or becomes attached to the sides and roof in beautiful festoons of pure white crystals resembling snow.

At stated intervals each section is cut out from the system and the accumulated deposit of white arsenic is shoveled into hand barrows and carried to storage-bins until needed for subsequent refining in a small reverberatory furnace.

After the arsenic has been expelled by the roasting, the ore is discharged from the furnace and treated with lead ore in a shaft furnace for the extraction of the gold and silver contents.

Despite the fact that the domestic output of arsenical compounds is not sufficient to supply more than one-quarter of the total consumption in the United States (large quantities being annually imported from Canada, Germany, and Spain), the development of this important industry is of exceedingly slow growth.

The manufacture in the United States of arsenic compounds from domestic ores should be developed, in order to supplant the large quantities which are annually imported from Europe and Canada. A glance at the table of imports given on page 10 of this report shows the growing importance of this branch of the arsenic industry. During 1903 there were imported from Canada, England, Germany, and Spain 1,211,299 pounds of arsenious acid, valued at $38,505, and 7,146,362 pounds of arsenic sulphide and orpiment, valued at $256,097, as compared with 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, in 1902.

The white arsenic trade is peculiar, in that its consumption depends on a number of variable conditions. Much of the product is used by sheep raisers to kill 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 either to the extermination of the tick or to the accumulation of stocks by the sheep raisers; and as a result there was an increase in the quantity exported from Germany and England to the United States during 1903, at prices which hindered to some extent the development of the industry in the last-named country.

Prior to the year 1899 the world's demand for arsenic and its compounds was met by the output of the arsenic mines of Cornwall and Devon, in England, and of the by-products from the metallurgical works at Freiberg, Germany, at which arsenious oxide is made, not only from arsenic ores, but also from arsenical ores of other metals, thereby rendering the latter more amenable for subsequent treatment and consequently more valuable.

It is probable that the future of the arsenic industry in the United States depends more upon the beneficiation of arsenical ores of other metals (chiefly those containing gold and silver) than upon the direct treatment of arsenic ores for the extraction of the metal itself.

A recently discovered deposit of arsenic is being exploited by the United States Arsenic Mineral Company of Pittsburg, Pa., at Pilot Mountain, 17 miles from Christiansburg, Montgomery County, Va. A statement from this concern outlining its work up to January 1, 1904, reports the driving of a 215-foot adit into the hillside, supplemented with a 55-foot drift extending to an 8-foot vein of arsenic ore of 25 per cent arsenic content, which can be mined at a cost of 70 cents per ton. A building 300 by 70 feet has been erected for the mills and furnaces, and dwelling houses, store, office, laboratory, and other buildings have been built. The plant is equipped with a 125-horsepower Westinghouse engine; two 75-horsepower return-tubular boilers; four dynamos, one of 75-horsepower and three of small power; a 13 by 20 inch Blake crusher; a 27-foot Howell-White calcining furnace; rolls, pumps, pulverizers, etc. The capacity of the plant, when completed, is placed at 140 tons of refined arsenic per month. The region is wild and mountainous.

The white-arsenic plant at the Washoe copper smelter, Anaconda, Mont., was nearly completed by January 1, 1904. Large brick settling chambers have been erected alongside of the flue of the Brunton roasting furnaces, in order to condense and collect the arsenical fumes formed during the roasting. The arsenic-refining department has been equipped with suitable reverberatory furnaces, in which the crude flue deposit will be refined and the purified product subsequently ground and packed for the market in air-tight barrels, each of a capacity of 400 pounds. The daily capacity of the by-product plant is reported to be several tons of flake arsenic.

An unconfirmed report went the rounds of the technical press during 1903 to the effect that the Mineral Creek Mining Company, owning an arsenic property at Mineral Creek, Washington, had mined and accumulated a stock of 1,000 tons of realgar (a sulphide ore of arsenic), which is awaiting the completion of a smelting plant at that place. Mineral Creek is situated near Elba, on the line surveyed for the Tacoma Eastern Railway.

An interesting discovery of metallic arsenic was made during 1903 at Washington Camp, Santa Cruz County, Ariz. The deposit is in masses attached to the walls of small pockets in dolomitic limestone. The size of the masses is generally small, although in one instance a piece weighing 20 pounds was found. This specimen is now in the National Museum at Washington, D. C. It is quite probable that other pockets containing arsenic would be found if the deposit were exploited, but, owing to the distance from the market and the high cost of fuel and labor, there appears to be no immediate prospect of developing the property.

WORLD'S PRODUCTION OF ARSENIC.

The statistics of the world's production of arsenic and its compounds from 1895 to 1903, inclusive, are given in the following table:

The world's annual production of arsenic, 1895–1903.[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	61,856
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	10	527	35,277
1902	726	48,000	2,827	260,000	(g)	(g)	(c)	736	33,068
1903	233	15,420	2,768	258,500	(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	(g h)	(g h)	272	$18,000
1902	(g)	(g)	2,165	96,910	(g h)	(g h)	1,226	81,180
1903	1,088	87,040	917	....	(g)	(g)	554	36,691

[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; in addition to these quantities, during 1903 there were produced 22 tons of orpiment, valued at $3,337.
[e] Arsenious oxide.
[f] Exports.
[g] Not reported.
[h] In 1901, 1902, and 1903 the quantity exported is reported at about 500 tons per year.

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 for the period 1893 to 1903, inclusive:

Imports of metallic arsenic, white arsenic (arsenious acid), and arsenic sulphides (orpiment and realgar) in the United States, 1893–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Pounds.			*Pounds.*	
1893	6,092,377	$180,333	1899	9,040,871	$386,701
1894	7,063,442	218,636	1900	5,765,559	265,500
1895	6,984,273	237,747	1901	6,989,668	316,585
1896	5,813,387	215,281	1902	8,110,898	288,065
1897	7,242,004	352,284	1903	8,367,661	294,002
1898	8,686,681	370,347			

PRICES.

The average monthly price per pound of standard English brands of white arsenic during the year 1903 was as follows: January, February, and March, 3 cents; April, May, and June, 3⅛ cents; July, 3 cents; August and September, 3⅛ cents; October, November, and December, 3⅝ cents.

Spanish white arsenic ruled lower than the English brands, due not to inferiority but to the comparative newness of the brand, which required a concession in price in order to establish its introduction in the New York market. It was reported that in October, 1903, a consolidation, having for its object an advance of prices, had been effected among the largest European manufacturers. That there was good authority for the unconfirmed rumor is attested by the fact that prices for arsenic white (including the Spanish brand) were firmly maintained at 3¼ cents per pound during the closing quarter of the year. The European combination, however, did not have sufficient control of the situation in the American market to continue the high price after the close of the year, mainly for the reason that American competitors promptly took advantage of the higher standard of price and placed a considerable quantity of the domestic product on the market. As a natural result the price declined early in the year 1904.

THE ARSENIC INDUSTRY IN FOREIGN COUNTRIES.

Canada.—The output of white arsenic in Canada during the year 1903 was 514,000 pounds, valued at $15,420, produced at the works of the Canadian Gold Fields Company (Limited), Deloro, Ontario. These works were closed early in the year for the reason that the changed character of the ore obtained from the lower levels of the mine necessitated a remodeling of the plant, and at the same time it was deemed desirable to enlarge the works also, so that an increased output could be made at a smaller cost per ton of product. It was also reported that the proposed consolidation of the interests of several companies in that district was an additional factor in shutting down the works.

The manufacture of white arsenic as a by-product in the treatment of arsenical gold ore has been carried on very successfully in recent years by the Canadian Gold Fields Company (Limited), the production being 113,474 pounds in 1899, 606,523 pounds in 1900, 1,346,983 pounds in 1901, 1,600,933 pounds in 1902, and 514,000 pounds in 1903, the works being operated only during the first three months of the last-named year. At the end of this time the deposits of arsenical gold ore above the water line, containing only a small per cent of arsenic, had become exhausted, and the remaining ore was essentially an arsenic ore carrying a small quantity of gold. A description of the Canadian arsenical gold ores and their metallurgical treatment is given in Mineral Resources for 1902.

In Hastings County, Ontario, there are many extensive deposits of arsenopyrite, generally containing gold to the extent of from 2 to 6 pennyweights per ton. In most cases these ores are free from zinc and lead, and therefore are exceptionally well suited to the production of white arsenic. The Canadian Gold Fields Company (Limited), at Deloro, has developed a cheap process for the direct extraction of gold from this class of ore in the raw state—i. e., without previous roasting, the reported cost being less than $1.50 per ton of ore treated. This fact naturally makes the field for arsenic a very promising one, and it is within the range of possibility that in the future Canada will become the source of arsenic supply not only for the United States but for Europe as well. In the latter country most of the old works have been closed down on account of the high cost of production. The white arsenic produced from the Deloro ore is of exceptional purity, analysis showing from 99.6 to 100 per cent of arsenious oxide. Furthermore, its freedom from sulphur has gained for it a world-wide reputation for excellence. It is stated on good authority that at Deloro the cost of making white arsenic is about one-third of the cost at Cornwall, England. This economy has resulted largely from the application of modern methods of treatment.

Arsenical ores also occur at other places in Canada, notably metallic arsenic and mispickel in Nova Scotia, and other ores in British Columbia, in Western Ontario, and in the Sudbury district. The latest reported discovery of arsenical ore is a deposit of smaltite (nickel arsenide) on the line of the Simis Kaming Railroad, now being built by the Ontario government.

Spain.—During 1903 the firm of Girones y Henrich completed the construction of a smelting plant at Badalona, 6 miles north of Barcelona, and began to produce white arsenic. At this plant auriferous arsenical pyrite, argentiferous galena, and cupriferous pyrite, obtained from the numerous small mines in the province of Gerona, are treated, and in the year 1903 the company treated 5,737 metric tons of mispickel, from which 1,088 tons of white arsenic, valued at 435,200 pesetas ($82,994), were produced.

United Kingdom.—According to the Fortieth Annual Report on Alkali Works, etc., by the chief inspector (published in 1904), a further reduction took place in the number of works registered for the manufacture of white arsenic in the United Kingdom. Ten years ago, in 1893, more than 35 works, situated in Cornwall, Devon, and South Wales, were engaged in the manufacture of white arsenic and an output exceeding 5,000 tons of refined material was made, but during the year 1903 only 22 works were in operation, yielding less than 1,000 tons of product.

The decline in the English white arsenic industry has been due largely to the competition of foreign manufacturers. In 1899 the Great Devon Consol arsenic mine, one of the most important in England, was shut down; and recently the entire metallurgical plant was dismantled and the mine shafts were allowed to become flooded by drainage water. During 1903 a small output of arsenic was produced by this company from the waste arsenical pyrite of the dump heaps, but the work was conducted on a small scale during a very limited period only. At the close of the year 1903 there were probably not more than 500 tons of "Drayton" arsenic in stock.

TIN.

By Joseph Struthers and Joseph Hyde Pratt.

INTRODUCTION.

As in former years, there was no commercial production of tin from domestic ores in the United States during the year 1903, although many hundred tons of metallic tin and chemical salts of tin, chiefly the chlorides, have been obtained by the chemical or electrolytic treatment of new tin scrap from tin can and fruit tin factories. But as tin from these sources is manifestly of secondary origin the quantity so produced can not be properly classified as a first mineral or metal product in the sense that these terms are used in the statistics presented by the United States Geological Survey.

The treatment of new tin scrap, known as "detinning," has become of considerable importance in the United States, and at least ten companies were actively engaged in this special branch of the industry during the year 1903. The average yield from tin scrap is approximately 2 per cent of metallic tin. In addition, a large number of small concerns in the principal cities recover the tin from old tin cans and similar material by a smelting treatment in a furnace, the tin being obtained in the form of solder, which is either used as a basis for making new solder or is treated chemically to yield metallic tin or tin salts. The residue of scrap iron is generally utilized in the manufacture of sash weights and other castings of inferior quality of iron.

A smelting plant for the furnace treatment of tin ores was erected at Bayonne, N. J., during 1903. The works included four reverberatory furnaces of a combined capacity of 50 tons of ore a day. The plant was designed to treat tin-ore concentrates from the Malay Peninsula, but before the completion of the works a prohibitory tax was placed on the export of tin ore from the Malay Peninsula, which destroyed the immediate prospects of the company operating the plant.

SOUTH DAKOTA AND WYOMING.

The mineral cassiterite, tin dioxide (SnO_2), containing 78.6 per cent of metallic tin, has been found in no less than 17 States and Territories of the United States, yet in only two or three places have attempts on a large scale been made to place the industry in this country on a productive footing. Notable among the discoveries of domestic tin ore are the deposits at Harney Peak, in the Black Hills of South Dakota, and the deposits in North and South Carolina, and in Alaska. The development of these deposits, however, has not as yet been carried forward to a commercially productive stage.

The Harney Peak Tin Mining, Milling, and Manufacturing Company reports, through its receiver, that during 1903 there has been no development of the properties beyond the regular amount of work required for the annual assessment. The court having jurisdiction would not permit the company to make any extended test of the properties or expend any money except in connection with a part of the placer ground, concerning which it was necessary to satisfy the Land Office that tin ore was present in the gravels. There was abundant proof of the presence of tin ore, but the experiments were on too small a scale to determine accurately the average quantity of tin that the gravels would yield.

Although there has been no appreciable development of the Harney Peak properties, the Tinton Tin Company, controlled by Chicago interests, has been working during the last two years on its claims located in what is known as the "Nigger Hill" and "Bear Gulch" districts, west of Deadwood and Lead, S. Dak., and 75 miles northwest of Harney Peak. This new district is partly in Lawrence County, S. Dak., and partly in Crook County, Wyo., being on the border line of the two States. The Tinton Tin Company has been operating a small concentrating plant, but owing to the lack of proper smelting facilities in the United States it has shipped to European ports for treatment a carload of concentrates said to contain an average of 62.5 per cent of metallic tin.

A thorough sampling of the deposit, subsequently confirmed by mill runs of several hundred tons of ore, has proved the existence of large blocks of ground that contain workable quantities of tin ore. One parcel of property, 140 by 50 feet, and another 90 by 6 feet, yielded an average mill return of 1.16 per cent of metallic tin, which was 0.16 per cent greater than the assays of hand samples made in the laboratory. The cassiterite in the properties of the Tinton Tin Company occurs in pegmatite greisen or altered granite, and is generally in the form of coarse granules, although at times large masses of fine grains of the mineral are found between the strata of the schist and the porphyry. The concentrating mill of the company is equipped with crushers, rolls, and a Bartlett table.

The quantity of ore so far treated has averaged 1 per cent of metallic tin and the concentrates therefrom have ranged from 62.5 to 65 per cent of metallic tin. The metalliferous impurities present consist of a very small quantity of pyrite and iron sesquioxide.

ALASKA.

The tin deposits of the York region, Seward Peninsular, Alaska, have been fully described by Arthur J. Collier,[a] in Bulletin No. 229, of the United States Geological Survey, published in 1904.

In the year 1900 Mr. Alfred H. Brooks, of the United States Geological Survey, discovered tin ore in the placers of the Anikovik River and its tributary, Buhner Creek. It was not until 1902, however, that the occurrence of tin-bearing gravels was discovered on Buck Creek, 20 miles north of the town of York. During 1903 Mr. Collier reported upon the tin-ore deposits of Lost River, Buck Creek, and Cape Mountain, the results of his investigations being embodied in the bulletin referred to. Mr. Collier concludes his report for the Survey with a brief description of tin ores and associated minerals, the methods of assaying tin ore, the occurrences of tin ores in the United States, the production of tin in foreign countries, and a list of the more important papers relating to tin deposits that have been published in recent years.

Several tons of tin ore have been shipped from the deposits of Buck Creek, and several companies have been operating their claims during 1903. In one instance an average of 27 pounds of concentrates containing 60 per cent of metallic tin were obtained from a cubic yard of gravel.

Cassiterite is found irregularly distributed over an area of 450 square miles of the Seward peninsula, and though many discoveries of lode tin other than those referred to in the preceding paragraph have been prospected none has yet been proved of workable value.

CAROLINA TIN BELT.

By Joseph Hyde Pratt.

GEOGRAPHICAL LOCATION.

What may be called the Carolina tin belt extends from Gaffney, Cherokee County, S. C., in a general northeasterly direction across this county, across the southeastern corner of Cleveland County, N. C., and across Gaston and Lincoln counties, N. C. The tin deposits found in Rockbridge County, Va., may be a continuation of the Carolina tin belt across Catawba, Iredell, Yadkin, and Surry counties, N. C. The general direction of the rocks carrying the tin ore is the same as that of the rocks in Virginia, and the continuation of this direction from the Carolina deposits would approximately cross those places in Rockbridge County, Va., where tin ore has been found. The rocks that outcrop in Surry County, N. C., are also in this same line and have the

[a] Collier, Arthur J., The Tin deposits of the York Region, Alaska: Bull. U. S. Geol. Survey, No. 229, 1904.

same general direction. The principal locality in South Carolina where tin ore has been found is about 1 mile north of Gaffney, on land belonging to Capt. S. S. Ross. For a distance of 13 miles from a point about a mile northeast of the Ross mine no tin minerals have as yet been found. The next place in the belt where tin is known to occur is a short distance northeast of Grover, S. C., a station on the Southern Railroad. From this point tin ore has been found almost continuously for over 14 miles to within a few miles of Lincolnton, Lincoln County, N. C., and it is reported to have been found a few miles northeast of Lincolnton, but no authenticated record of this discovery can be obtained. No tin has thus far been found in North Carolina northeast of the Lincolnton locality nor in Virginia until the Rockbridge County deposits are reached.

The principal deposits that have thus far been located are the Ross mine at Gaffney, S. C.; the deposits in the vicinity of the town of Kings Mountain, N. C.; on the southern end of Chestnut Ridge, about 2½ miles northeast of Kings Mountain; and on the John E. Jones plantation, 7 miles northeast of Kings Mountain.

The Southern Railroad passes over a considerable portion of the tin belt, following almost the general direction of the formation from Kings Mountain to Gaffney. At the former place the railroad turns sharply to the east, crossing the tin belt, which continues toward the northeast. Thus, any commercial deposits that may be developed will have good railroad facilities, not being more than a few miles from the railroad. Those on Chestnut Ridge are not over 2 miles from the railroad, and the ore mined could easily be hauled to the railroad at small expense. If the Jones deposit proves to contain tin in any large quantity it would still be profitable to haul the ore to the railroad at Bessemer City, a distance of about 4 miles, if it did not prove feasible to build the railroad to the deposits.

GEOLOGY.

The section of North Carolina and South Carolina in which the tin belt occurs is close to the border of the large area of Archean gneisses, which extend over a large portion of the western part of North Carolina and the northwestern part of South Carolina. Bordering these gneisses on the east there is a series of granites and other igneous rocks extending from Cherokee County, S. C., across Mecklenburg, Cabarrus, Rowan, Davidson, Guilford, Caswell, and Person counties, N. C., which have a general north to northeast direction. At the extreme southern portion of North Carolina and extending into South Carolina there is between these granites and gneisses a band of metamorphic rocks, consisting of slates, schists, limestones, quartzites, and conglomerates, whose age is unknown. These occur quite extensively developed in Cherokee County, S. C., and in Gaston, Lincoln, and

Catawba counties, N. C., and extend for a very short distance into Iredell County, N. C. No more of these rocks are observed in this northeast direction until they again outcrop in the northeastern portion of Yadkin County, whence they extend nearly across Stokes County and almost to the Virginia line. They are in every way identical with those found farther south, and represent the same geological formation. Penetrating these rocks in Gaston and Lincoln counties, N. C., there is a mass of granite which is from 5 to 10 miles wide.

The general strike of these metamorphic rocks is northeast. It is in this belt of metamorphic rocks in North Carolina that the tin ore is found. The veins carrying the tin have approximately the same strike as the metamorphic rocks, but near the South Carolina line there is a rather sharp bend to the westward, so that from there to Gaffney, S. C., the direction of the tin belt is about N. 55° E., and it leaves the schists to the east and passes through the Archean gneisses. The rocks in the vicinity of Gaffney, S. C., are almost entirely gneisses, similar to those found in North Carolina to the west of the metamorphic rocks. These gneisses have been referred to the Archean rocks. There are, then, rocks of two distinct geological periods in which the tin veins have been found: (1) Those associated with the Archean gneisses, which are found in the vicinity of Gaffney, S. C., and (2) those associated with the schists, which are of a later period and with which all the North Carolina tin is found.

As has been stated above, the main country rocks are for the most part crystalline schists and gneisses, the former being micaceous, chloritic, and argillaceous, and the latter micaceous and hornblendic. The strike of the schistosity of these rocks is usually in a general northeast direction and they dip for the most part at very steep angles to the westward. The veins in the gneisses dip toward the east at very steep angles.

The Kings Mountain region of North Carolina is geologically situated in a band of metamorphic rocks composed of slates, schists, limestones, quartzites, and conglomerates, whose age up to the present time has not been definitely determined. The width of this belt near Kings Mountain is about 10 miles, and it extends in a direction about N. 10° to 20° E. Just east of Lincolnton, Lincoln County, it joins another band of similar rock, the two being separated east of Kings Mountain by a mass of granite. To the west of these metamorphic rocks are the Archean gneisses, with which the tin veins of Gaffney, S. C., are associated. The strata of these metamorphic rocks are tilted at very high angles to nearly vertical, and, in the resultant alteration and erosion to which they have been subjected, the quartzites have resisted these influences the most, so that they now form the tops of the peaks and ridges, such as Kings, Crowders, and Anderson mountains, which rise 500 to 1,000 feet above the average elevation. It is undoubtedly the mass of granite to the east that has tilted these metamorphic rocks and thrown them into their present position.

There are several amphibolite dikes that have been observed cutting these schists, but they have made very little change in the position of the schists through which they penetrated beyond a metamorphic action. These sedimentary rocks were tilted into their present position before the intrusion of these dikes, which follow partly the lamination of the schists and their general trend, but in a few instances cut across the schist. In two or three instances, where these dikes cut across the schists, there are approximately parallel to them veins of tin ore. Pegmatitic dikes are also common throughout this belt of metamorphic rocks in North Carolina and in the gneisses farther to the west in South Carolina. They may be followed almost continuously from 3 miles above Grover, S. C., to the Jones mine, 7 miles northeast of Kings Mountain, N. C. In one place a short distance below Kings Mountain the pegmatitic dike is fully 200 feet wide. They follow in many cases the planes of the lamination of the schist, which represent lines of least resistance. Where the pegmatitic dikes cut across the schists they may be following old fractures that were produced at the time of the intrusion of the amphibolite dikes.

About one-half mile below Kings Mountain the pegmatitic rocks begin to outcrop very boldly and continue in this way nearly to Grover, S. C., a distance of 7 miles. This mass of pegmatite varies a good deal in width in this distance—from 25 to 600 feet. Just in the northern edge of the town of Kings Mountain there is another strong outcrop of the pegmatite, but from this point there is but little seen of it to the northeast until Ransom's mill is reached. Here the pegmatite has a width of about 200 feet.

A cross section of the tin belt in the vicinity of Kings Mountain would show the following sequence: Hornblende gneiss on the western boundary, followed on the east by schists which are in many places very badly decomposed; then a narrow bed of limestone which is more or less siliceous; then quartzite; another bed of limestone; quartzite; schist; and then the granite on the extreme eastern portion of the belt, the cross section having a total width of about 10 miles.

The term greisen is given to a granitoid rock composed essentially of quartz and muscovite or some related mica rich in fluorine, and it is associated with this type of rock that the cassiterite, when occurring as an ore of tin, is nearly always found.

The tin ore of the Carolina belt occurs in greisen veins in the main mass of mica schist adjoining the gneiss on the west and extending in almost a continuous belt from the South Carolina line to a few miles northeast of Lincolnton, N. C. The width of this schist formation is approximately 1 mile, and it is bordered on the east by the limestone. In South Carolina, where the belt has made a bend toward the west, the tin ore occurs in the greisen veins that are in gneiss.

Where the tin occurs in the large pegmatitic dikes, it is on their boundaries where the fumarole action would be the greatest. It has been observed, however, for the most part, in lens-shaped masses of greisen, which are commonly found in laminated metamorphic rocks, especially schists, when pegmatitic dikes are intruded into these rocks, and are often called "augen." In these lenses in the schist that carry tin there is usually no feldspar present, but similar lenses are observed in the schist that do contain considerable feldspar. These, however, contain little or no tin.

In the vicinity of Gaffney, S. C., the greisen veins carrying tin, which are in gneiss, all contain more or less feldspar which has been nearly or completely altered to kaolin.

MINERALOGICAL AND CHEMICAL CHARACTER OF THE ORE.

Cassiterite, the tin-bearing mineral of the veins, is an oxide of this metal, whose formula is SnO_2 and which contains theoretically 78.6 per cent of metallic tin. When chemically pure this mineral is nearly white in color, but it usually contains more or less ferric oxide, and its color varies from reddish to brown or black, varying with the percentage of iron. Arsenic is also found in this mineral, and an arsenical cassiterite is usually yellowish in color.

The mineral is tetragonal in its crystallization, and though in certain localities it is sometimes crystallized, it more often is granular and in rough masses, especially where it is found in commercial quantity. The crystals are usually prismatic and are often twinned, both as contact and penetration twins. It is a brittle mineral, having an imperfect cleavage, and breaking usually with a subconchoidal fracture.

Its hardness is from 6 to 7 and its specific gravity varies from 6.16 to 7.1, according to the amount of impurity in the mineral. When the percentage of iron is low the crystals are nearly transparent, but they become nearly opaque with the increasing percentage of iron oxide. Its luster is adamantine, but the crystals are usually splendent.

There are three varieties of cassiterite, recognized as follows:

1. Ordinary or tin-stone, which is the crystalline and massive variety obtained directly from the vein or from the broken-down material just below the vein.

2. Wood tin, which is in botryoidal and reniform shapes, with a concentric structure which internally is fibrous, but very compact. Its color is brownish, but of mixed shades, with the resulting appearance and color of dried wood.

3. Stream tin is the mineral in the form of sand, as it is found concentrated along the beds of streams and in the gravels below the veins.

None of the wood tin has been found in the Carolina belt, but the ordinary or tin-stone and stream tin occur abundantly. Crystallized cassiterite, though not common, has been found, the better crystals having been obtained thus far from the Jones mine, in North Carolina. The only face that has been observed on any of these crystals is the pyramidal face, *s*, 111. The crystals occur both simple and twinned with *e*, 101, as the twinning plane. The crystals are small, from a quarter to half an inch in length, and are usually of a black color. They are fairly well developed, with most of the edges sharp and distinct. Some, however, are considerably elongated. All the faces are more or less corroded and striated. Rough, partially crystallized cassiterite is found at many places throughout the belt, and from the Faires property just south of Kings Mountain one rough crystallized fragment was found which weighed nearly one-half pound. The color of the cassiterite found in the Carolina belt varies from black to almost colorless, the common color being a dark brownish black, and more rarely a light grayish.

Partial analyses have been made of two varieties of the cassiterite found in and about the town of Kings Mountain, N. C., one a light grayish and the other a dark brown. The results of these analyses by Prof. C. W. Dabney are given in the table below:

Partial analyses of cassiterite from Kings Mountain, N. C.[a]

Constituent.	Light grayish.	Dark brown.
	Per cent.	*Per cent.*
Stannic oxide	94.70	82.99
Tungstic oxide	.92	1.14
Sulphur	Trace.	.46
Arsenic	Trace.	Trace.

[a] Genth, F. A., The Minerals of North Carolina; Bull. U. S. Geol. Survey No. 74, 1891, p. 35.

As is seen from these partial analyses, the percentage of stannic oxide in the light grayish variety is much higher than that in the dark brown, and this is due probably to the larger per cent of iron that was in the latter sample. These percentages of stannic oxide would correspond to 74.41 per cent of metallic tin in the light gray sample and to 65.21 per cent in the dark brown.

There is a noticeable difference in the occurrence of the cassiterite in the veins of the southern portion of the belt from the occurrence toward the north. At the Ross mine, near Gaffney, S. C., the cassiterite is associated with more or less feldspar (which has been partially kaolinized and in some cases completely altered to kaolin), with muscovite mica, and with but little quartz. Consequently at the present stage of the development work but little solid ore is obtained, the cassiterite being readily separated from the vein material or gangue minerals without the need of any crushing. As the belt is followed north, however, quartz becomes more abundant, and the veins are composed principally of quartz with mica and cassiterite, thus making a firm, compact ore. This latter occurrence would make a true, typical greisen. In this section of the belt it is common to find, scattered over the surface, bowlders weighing from a few pounds to 150 or more pounds and composed of quartz, mica, and cassiterite. The tin, as a rule, is embedded more in the mica than in the quartz, and the mica in the greisen veins containing tin has a pale apple-green color and is fluoric. There is a small amount of partially altered feldspar occasionally found associated with these veins in the schist. This variation in the occurrence of the tin is due to the country rocks in which the veins occur, those to the north being in the mica schist, while those at the Ross mine cut a hornblende gneiss.

A small quantity of jet black tourmaline in rough, prismatic crystals and minute needles has been found directly associated with tin both in the quartz and in the feldspar veins; but it is rare to find it directly associated with the tin. It is, however, very commonly found just to one side of the vein in the schist or gneiss, and in some instances it represents a tourmalinization of the wall rock. A little magnetite is also occasionally found. Thus far no fluorite nor any of the tungsten minerals have been identified in these veins, although a fraction of a per cent of tungstic oxide was obtained in the analysis of the cassiterite.

Pyrite, an iron sulphide, is found to some extent in the schists, but thus far it has been observed only very sparingly directly associated with the tin in the greisen veins. Chalcopyrite, a copper-iron sulphide, has been reported by Mr. John H. Furman,[a] as occurring in some of the deeper tin workings.

In the concentrates of cassiterite obtained from the washing of soil and gravel at various places along this belt there is a greater variety of associated minerals found with the tin. The associated minerals of the stream tin are magnetite, ilmenite (or menaccanite), garnet, monazite, tourmaline, quartz, a little pyrite, and chalcopyrite very sparingly. Of these minerals, monazite and garnet are confined principally to the concentrates obtained from the breaking down of the tin veins occurring in gneiss. The monazite was observed in considerable quantity in the fine concentrates from the stream tin obtained from the gravels in the vicinity of the Ross mine. Occasionally there is a considerable percentage of monazite found, and one lot of concentrates obtained from the Ross mine that was tested contained 55 per cent of tin oxide and 20 per cent of monazite, besides considerable garnet. It is in these same gneisses, in Cleveland, Burke, Lincoln, Rutherford, and McDowell counties, N. C., that the monazite, which is mined commercially, originates.

[a] Trans. N. Y. Acad. Sci., vol. 8, 1888-89, p. 144.

Regarding the ilmenite, which is found so abundantly associated with the tin in the gravels, it is to be noted that little or none of this mineral has been observed associated with the tin in the veins. There are, however, pegmatitic veins which carry a considerable amount of ilmenite, but such veins carry little or no cassiterite.

The position of the cassiterite in the vein varies considerably. In some instances, as in a 2½-foot dike at the Jones mine, the tin is rather evenly distributed throughout the vein, while in others, as at the Ross mine, the tin is concentrated in seams, which are for the most part close to the eastern hanging wall. It is also to be noted that most of the tourmalinization that was observed was to the east of the tin-bearing veins.

Many of the lenses of greisen, as they were followed downward, pinched out or narrowed to a thin seam, but usually before one gave out another would be encountered.

In order to obtain some idea of the percentage of cassiterite the veins contained, a sample was taken across the 2½-foot vein at the Jones mine, which gave, on crushing and panning, a concentrate of practically pure cassiterite, representing 5 to 6 per cent of the vein. This would be equal to about 3½ per cent metallic tin. An ore carrying such a percentage of tin would, if in quantity, make a profitable proposition. Favorably located deposits have been worked that did not carry over 1½ per cent of metal.

It is to be noted, however, that (with the exception of the Cornish tin mines) most of the world's production of tin is obtained from alluvial deposits and not from vein formations. The alluvial deposits at the Ross mine, Gaffney, S. C., have been estimated, from the work that has been done, to carry about 25 pounds of metallic tin per cubic yard.

PRODUCTION OF TIN FROM THE CAROLINA BELT.

The first production of tin ore from the Carolina belt was during the summer and fall of 1903 and was from the Ross mine, the shipment consisting of 38,471 pounds of tin concentrates, which were sent to England for treatment. There has also been a small production at the Jones mine during the development work, but none of this has as yet been shipped.

WORLD'S PRODUCTION OF TIN.

At the present time none of the tin used in the United States is produced in this country, but it is all obtained from foreign sources. The fact that about 43 per cent of the world's production of tin is consumed in the United States emphasizes the importance of discovering a source of supply of this metal that can be controlled by this country. It is hard to obtain accurate figures regarding the total production of tin in the world, for the reason that in some countries there is little or none exported, and no reliable statistics of their mineral production are collected in these countries. For instance, in China there is at the present time practically no exportation of tin, although occasionally exports have been made of Yunan tin. The production of tin in China has been variously estimated and has been put as high as 20,000 tons per annum; but although these figures are undoubtedly too high, no figures can be given which would more accurately represent the production. There is also a certain quantity of tin produced each year in Mexico, a very small part of which is exported to the United States; but as no accurate record is kept of the quantity obtained, the total can only be approximately represented in the world's total production. Then, again, the statistics regarding the Bolivian production of the tin that is used in that country are difficult to obtain, although accurate statistics are available of the quantity exported. In the following table there is given an approximate idea of the production of tin by countries during the last seven years, which shows the growth of the tin industry as well as the yearly production of each of the countries named:

Production of tin in the world, 1897–1903.[a]

[Long tons.]

Country.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Malay States	44,914	45,901	45,944	47,855	52,989	53,756	54,797
Banka and Billiton	14,800	14,380	14,123	16,640	19,365	18,765	20,060
Bolivia	5,506	4,464	4,753	6,937	9,670	10,150	9,500
Cornwall, England	4,453	4,648	4,013	4,268	4,125	3,950	4,150
Australia	3,466	2,420	3,337	3,178	3,276	3,206	4,991
Miscellaneous[b]	360	655	970	760	450	350	395
Total[c]	73,499	72,468	73,140	79,638	89,875	90,177	93,893

[a] Mineral Industry, 1902, p. 586; Eng. & Min. Jour., Jan. 7, 1904, p. 18.
[b] Includes production in Austria, Germany, Japan, Mexico; and in 1903 from South Carolina.
[c] This does not include the production of China.

As is seen from this table, there has been an increase in the total quantity of tin produced each year, but this is still short of the demand for this metal as indicated by the great decrease in the stocks of tin that have been kept on hand in the various countries. The production of the Malay Peninsula, the largest producer, has increased about 22 per cent during the last seven years; that of the islands of Banka and Billiton, the second largest producers, has increased about 35 per cent; and Bolivia, the third largest producer, has increased its production about 80 per cent. England's production has declined slightly, and the Australian production, which is fifth, has increased about 44 per cent.

CONSUMPTION AND IMPORTS.

The production of tin during 1903 was consumed approximately as follows: Forty-three per cent by the United States, 28 per cent by Great Britain, 22 per cent by other European countries, and 7 per cent by India and China. This of course does not include the small quantities produced and used in Mexico, Japan, Bolivia, etc.

The tin consumed in the United States for the year ending June 30, 1903, was obtained, according to the report of the Bureau of Statistics of the Department of Commerce and Labor, from the countries named in the following table, which also gives the quantity and value obtained from each:

Imports of tin into the United States for the year ending June 30, 1903.

Country.	Tin in bars, blocks, pigs, or grain or granulated.	
	Quantity.	Value.
	Short tons.	
Malay Peninsula	23,592	$12,715,875
England	17,591	9,374,563
Netherlands	1,726	944,304
Other European countries	853	441,114
Australia	224	119,851
Japan[a]	42¼	23,095
Total	44,028¼	23,618,802

[a] Includes a very small amount from China and Mexico.

It will be noticed in this table that the quantity quoted as having been imported from Great Britain is nearly four times that produced in England. This is due to the fact that a considerable portion of the tin produced in the Malay Peninsula is shipped from Singapore to Great Britain and is in turn imported from there into the United States. Thus it will be seen that the greater part of the tin consumed in the United States is mined in the Malay Peninsula. That imported from the Netherlands represents tin that was obtained from the islands of Banka and Billiton. Some of the tin imported from other European countries was obtained from Bolivia.

The following table shows the imports of tin into the United States in 1903 by countries:

Imports of tin into the United States in 1903 by countries.

Country.	Tin in bars, blocks, pigs, or grain or granulated.	
	Quantity.	Value.
	Pounds.	
United Kingdom	37,477,423	$10,161,067
Netherlands	2,367,055	618,482
Other Europe	859,828	226,743
East Indies	41,750,451	11,081,947
Other Asia and Oceania	576,060	152,504
Other countries	103,030	24,624
Total	83,133,847	22,265,367

The following table shows the imports of tin into the United States from 1898 to 1903, inclusive:

Imports of tin into the United States, 1898–1903.

Year.	Pounds.	Value.	Year.	Pounds.	Value.
1898	62,748,399	$8,770,221	1901	74,560,487	$19,024,761
1899	71,248,407	16,748,107	1902	85,043,353	21,263,337
1900	69,989,502	19,458,586	1903	83,133,847	22,265,367

SOURCES OF SUPPLY OF TIN.

The main source of supply of tin is from the Malay States, which furnish over one-half of the total quantity consumed in the world. To increase this supply to any great extent is almost out of the question, at least for the present, on account of the necessity of making very decided changes in the methods of mining, which is well-nigh impossible, as most of this mining is in the hands of the Chinese. The same is true of the islands of Banka and Billiton, which produce one-fifth of all the tin used in the world. The deposits of the Chinese Empire are in so remote a part of the country that little is known of their extent or of their yearly production. This production is, however, at the present time, practically all consumed in China. The Bolivian mines, which now furnish about one-tenth of the world's supply of tin, have been constantly increasing their production during the last ten years, and during this time they have nearly doubled their annual output. On the other hand, the production from Tasmania and England has been decreasing.

STOCKS.

Although there has been a slight increase in the total quantity of tin produced each year, the supply does not equal the demand. In order to illustrate the increase in the demand for this metal, there is shown in the following table the accumulated stocks of tin that were on hand at the end of each of the last seven years:

Stocks of tin in England, America, and Holland, 1896–1902.[a]

[Long tons.]

	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Stock of foreign in London	18,097	15,146	8,110	5,486	4,286	5,114	4,557
Foreign landing in London	1,174	673	165	1,212	1,297	689	712
Malay Peninsula afloat for London, including wire advices	2,792	2,500	1,050	2,900	3,835	2,780	2,845
Australian afloat for London, including wire advices	525	600	400	450	350	522	518
Banka on warrants in Holland	1,616	2,877	2,228	1,160	837	696	644
Billiton in Holland	1,638	1,328	1,086	478	330	329	60
Billiton afloat for Holland	1,742	1,193	1,822	1,050	350	440	233
Malay Peninsula stock in Holland	789	377	454	100	60	30	....
Malay Peninsula afloat for Holland	950	100	215	....	....	....	....
Malay Peninsula afloat for Continent	650	600	560	450	590	873	650
Bolivian in Liverpool	250	710	300	550	495	846	184
Total stocks	30,223	26,104	15,840	13,828	12,430	12,319	10,503
Estimated stock in America and quantity afloat	3,925	4,500	4,300	2,500	2,600	6,050	4,450
Grand total	34,148	30,604	20,140	16,328	15,030	18,369	14,953
Trading Company's reserves of unsold Banka stock in Holland	5,953	4,333	3,218	4,353	5,347	7,251	1,466

[a] From the annual metal circulars of William Sargant & Company and A. Strauss & Company; Min. Industry, 1903, p. 587.

It appears from this table that there was only one year, 1901, that showed any increase in the accumulated stock of tin at the end of the year over that of the previous year. In 1901 there was an increase of 3,339 tons of tin in the accumulated stock, but at the end of 1902 the stock on hand had decreased to 14,953 tons of accumulated tin, and at the end of 1903 the stock was still smaller. The accumulated stocks of tin in Holland, which had ranged from about 3,500 to 7,200 tons during the years 1896 to 1901, were reduced during 1902 to less than 1,500 tons.

These figures illustrate emphatically the need of new sources of supply of tin, and show why new deposits like those in the Carolinas and Alaska should be thoroughly investigated.

One result of this scarcity in the supply of tin and consequently the high valuation of this metal has been the utilization of old tin cans and other scrap tin as a source of the metal. The amount of tin that is recovered each year in this way, while not large, is steadily increasing, and it is becoming an industry of some considerable importance. There are now a number of companies that have been organized for this purpose, of which the more important ones are the Vulcan Detinning Company, whose plants are at Sewaren, N. J., and Streator, Ill.; the Ammonia Company, of Philadelphia, and the Johnson and Jennings Company, of Cleveland and Chicago. In recovering the tin the scrap is digested in an alkaline solution and the tin electrolytically precipitated therefrom in the form of a powder which averages 80 per cent metal.

PRICES.[a]

The following table shows the average monthly prices of tin per pound in New York from 1899 to 1903, inclusive:

Average monthly prices of tin per pound in New York.

	1899.	1900.	1901.	1902.	1903.
	Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*
January	22.48	27.07	26.51	23.54	28.33
February	24.20	30.58	26.68	24.07	29.43
March	23.82	32.90	26.03	26.32	30.15
April	24.98	30.90	25.93	27.77	29.81
May	25.76	29.37	27.12	29.85	29.51
June	25.85	30.50	28.60	29.36	28.34
July	29.63	33.10	27.85	28.38	27.68
August	31.53	31.28	26.78	28.23	28.29
September	32.74	29.42	25.31	26.60	26.77
October	31.99	28.54	26.62	26.07	25.92
November	28.51	28.25	26.67	25.68	25.42
December	25.88	26.94	24.36	25.68	27.41
Year	25.12	29.90	26.54	26.79	28.09

[a] Min. Industry, 1904.

COAL.

By Edward W. Parker.

INTRODUCTION.

So far as those directly connected with the production of coal in the United States are concerned the record of the industry for 1903 was the most satisfactory one in recent years. Not only was the production the largest ever known, exceeding that of 1902 by over 55,000,000 short tons, but prices for both anthracite and bituminous coal reached the highest point recorded in a period of twenty-four years or during the entire time that the statistics of coal production and value have been collected by the Geological Survey. Labor employed in the production of coal received the highest wages known for many years, per unit of work performed, while in general the number of working hours was shortened, the average number of hours to the day being usually reported as eight or nine in the returns to the Survey.

Time lost by strikes was unusually little. The principal exceptions to a year of general industrial peace were experienced in Alabama and Colorado, nearly one-half of the total time lost by strikes being borne by those States. The terms of settlement of the anthracite strike carried with them an agreement to abide by the awards of the Commission for a period of three years, and although there have been some local disaffections growing out of differences of opinion in the interpretation of the awards, a conscientious determination on the part of both sides to carry out the agreement in good faith has been evident. Such differences as have arisen have usually been settled by the board of conciliation, or on appeal to the umpire, Hon. Carroll D. Wright.

There was also observed an improved condition in the transportation facilities, and the much larger tonnage of 1903 was handled to better satisfaction than was that of the preceding year. This was no doubt in part due to the resumption of anthracite mining and the supplying of that commodity to its natural markets and the doing away of the necessity for the longer hauls which were required to bring bituminous coals to the anthracite consumers during the strike period of 1902.

Except in the anthracite region, the shorter hours and higher wages did not apparently develop any greater intensity in the labor employed.

In the anthracite region there was a natural desire to make up for lost time, and the average daily production per man increased from 2.40 to 2.41. The average number of days worked in 1903 (206) was the largest recorded in the fourteen years that the Survey has collected such data, and the total tonnage per man for the year (496 short tons) was also the banner record. In bituminous production, notwithstanding a continued increase in the use of mining machines and a gain in the percentage of machine-mined coal, the average efficiency per man shows a decline. In daily production per man the statistics for 1903 show an average of 3.02 short tons as compared with 3.06 tons in 1902, and the yearly production per man shows a decrease from 703 short tons to 680 tons.

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 completeness of the statistics contained in these reports could not be secured without the good will and disinterested cooperation of the individual coal-mine operators and the officials of corporations engaged in the industry. The writer desires to express his sincere appreciation of the assistance received from this source. Acknowledgments are also due to the secretaries of boards of trade and other local authorities for contributions to the portion of this report included under the caption of Coal Trade Review. Recognition of these by name is given in connection with their contributions. The report on the production of Pennsylvania anthracite has been, as for several years past, prepared by Mr. William W. Ruley, Chief of the Bureau of Anthracite 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 1903 185,600,161 short tons, or 65.6 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 1903 52,130,856 short tons, or 18.43 per cent of the total. The Western coal field, the third in productive importance, contains 94,076 square miles, and produced in 1903 23,171,692 short tons, or 8.2 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 1903 16,981,059 short tons, or 6.01 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 1903:

Coal fields of the United States and their production, 1898–1903.

	Area.	1898.	1899.	1900.	1901.	1902.	1903.
Anthracite.	*Sq. miles.*	*Short tons.*	*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	74,607,068
Colorado and New Mexico	16	47,095	96,196	98,404	66,869	93,937	72,731
	500	53,429,739	60,514,201	57,466,319	67,538,536	41,467,532	74,679,799
Bituminous.[a]							
Triassic:							
Virginia	270	38,938	28,853	57,912	12,000	16,206	18,084
North Carolina	800					23,000	17,309
Appalachian:							
Pennsylvania	15,800	65,165,133	74,150,175	79,842,326	82,305,946	98,574,367	103,117,178
Ohio	12,000	14,516,867	16,500,270	18,988,150	20,943,807	23,519,894	24,838,103
Maryland	510	4,674,884	4,807,396	4,024,688	5,113,127	5,271,609	4,846,165
Virginia	1,850	1,787,831	2,104,334	2,353,576	2,725,873	3,166,787	3,433,223
West Virginia	17,280	16,700,999	19,252,995	22,647,207	24,068,402	24,570,826	29,337,241
Eastern Kentucky	10,300	1,591,076	1,871,550	2,222,867	2,268,892	3,019,757	3,158,972
Tennessee	4,400	3,022,896	3,330,659	3,509,562	3,633,290	4,382,968	4,798,004
Georgia	167	244,187	233,111	315,557	342,825	414,083	416,951
Alabama	8,500	6,535,283	7,593,416	8,394,275	9,099,052	10,354,570	11,654,324
	70,807	114,239,156	129,843,906	142,298,208	150,501,214	173,274,861	185,600,161
Northern:							
Michigan	11,300	315,722	624,708	849,475	1,241,241	964,718	1,367,619
Central:							
Indiana	9,300	4,920,743	6,006,523	6,484,086	6,918,225	9,446,424	10,794,692
Western Kentucky	5,800	2,296,832	2,735,705	3,106,097	3,201,094	3,747,227	4,379,060
Illinois	42,900	18,599,299	24,439,019	25,767,981	27,331,552	32,939,373	36,957,104
	58,000	25,816,874	33,181,247	35,358,164	37,450,871	46,133,024	52,130,856

[a] Includes brown coal or lignite, semianthracite, semibituminous, etc., and scattering lots of anthracite.

Coal fields of the United States and their production, 1898-1903—Continued.

	Area.	1898.	1899.	1900.	1901.	1902.	1903.
Bituminous—Continued.							
Western:	*Sq. miles.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Iowa	20,000	4,618,842	5,177,479	5,202,939	5,617,499	5,904,766	6,419,811
Missouri	23,000	2,688,321	3,025,814	3,540,103	3,802,088	3,890,154	4,238,586
Nebraska	3,200	....	....	....	....	....	....
Kansas	20,000	3,406,555	3,852,267	4,467,870	4,900,528	5,266,065	5,839,976
Arkansas	1,728	1,205,479	843,554	1,447,945	1,816,136	1,943,932	2,229,172
Indian Territory	14,848	1,381,466	1,537,427	1,922,298	2,421,781	2,820,666	3,517,388
Texas	11,300	686,734	883,832	968,373	1,107,953	901,912	926,759
	94,076	13,987,397	15,320,373	17,549,528	19,665,985	20,727,495	23,171,692
Rocky Mountain, etc.:							
North Dakota	28,620	83,895	98,809	129,883	166,601	226,511	278,645
Montana	32,000	1,479,803	1,496,451	1,661,775	1,396,081	1,560,823	1,488,810
Wyoming	16,500	2,863,812	3,837,392	4,014,602	4,485,374	4,429,491	4,635,293
Utah	2,000	593,709	786,049	1,147,027	1,322,614	1,574,521	1,681,409
Colorado	18,100	4,063,210	4,718,590	5,182,176	5,668,886	7,348,732	7,381,463
New Mexico	2,890	968,330	1,012,152	1,268,083	1,050,806	1,007,437	1,511,189
Idaho	....	1,039	20	10	....	2,030	4,250
Nevada	....	....	....	....	....	....	....
	100,110	10,043,798	11,949,463	13,398,556	14,090,362	16,149,545	16,981,059
Pacific coast:							
Washington	450	1,884,571	2,029,881	2,474,093	2,578,217	2,681,214	3,193,273
Oregon	320	58,184	86,888	58,864	69,011	65,648	91,144
California	280	160,288	160,972	171,708	151,079	84,984	104,673
Alaska	....	1,600	1,200	1,200	1,300	2,212	747
	1,050	2,104,643	2,278,941	2,705,865	2,799,607	2,834,058	3,389,837
Total production, including colliery consumption	....	219,976,267	253,741,192	269,684,027	293,299,816	301,590,439	357,356,416

Total production of each field, 1887-1903.

	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	88,938	114,239,156	315,722
1899	60,514,201	28,353	129,843,906	624,708
1900	57,466,819	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
1903	74,679,799	35,393	185,600,161	1,367,619

Total production of each field, 1887-1903—Continued.

	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	13,988,436	10,042,759	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
1903	52,130,856	23,171,692	16,981,059	3,389,837

In order to show the development of the six principal bituminous areas since 1887, the following table has been prepared which gives the quantity produced in each field in that year and also in 1900, 1901, 1902, and 1903, with the percentages of the total contributed by each, and with the increases in 1903 as compared with 1902 and with 1887:

Production of the six principal bituminous coal fields in 1887, 1900, 1901, 1902, and 1903 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	55,888,068	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.	1903.		Increase in 1903 over 1887.		Increase in 1903 over 1902.	
	Quantity.	Per cent of total.	Quantity.	Per cent.	Quantity.	Per cent.
	Short tons.		*Short tons.*		*Short tons.*	
Appalachian	185,600,161	65.64	129,712,073	232.09	12,325,300	7.11
Central	52,130,856	18.43	37,655,552	260.04	6,001,411	13
Western	23,171,692	8.20	12,999,058	127.78	2,444,197	11.79
Northern	1,367,619	.48	1,296,158	1,813.79	402,901	41.76
Rocky Mountain	16,981,059	6.01	13,334,779	365.70	831,514	5.14
Pacific coast	3,389,837	1.20	2,535,529	296.79	555,779	19.61

PRODUCTION.

Total production in 1903, 357,356,416 short tons; spot value, $503,724,381.

Pennsylvania anthracite.—Total production in 1903, 66,613,454 long tons (equivalent to 74,607,068 short tons); spot value, $152,036,448.

Bituminous and lignite.—Total production, 282,749,348 short tons; spot value, $351,687,933.

Compared with 1902 the total output of all kinds of coal in the United States during 1903 exhibits an increase of 55,765,977 short tons in quantity and of $136,692,312 in value. Three-fifths of this total increase in quantity, 29,672,744 long tons (or 33,233,473 short tons) was in the production of Pennsylvania anthracite, and two-fifths, or 22,532,504 short tons, was made up by the increased output of bituminous coal and lignite. Of the increase in value, Pennsylvania anthracite contributed $75,862,862, and bituminous coal and lignite $60,829,450. Owing to the great strike which prevailed in 1902 the production in that year does not present a fair standing for comparison. As compared with 1901, when more normal conditions prevailed in the anthracite region, the production in 1903 shows an increase of 6,370,894 long tons, or a little over 10 per cent, while as compared with the average yearly production of the previous five years from 1896 to 1900, inclusive, the average production for the last three years, notwithstanding the restricted output in 1902, showed an increase of 4,933,582 long tons. The value of the anthracite production in 1903 was almost exactly double that of 1902, and showed an increase of $39,532,428, or 35 per cent, over 1901. The average price per ton for the marketed sizes of anthracite coal at the mines in 1903 was $2.50, as compared with $2.35 in 1902 and $2.05 in 1901. The coal used at the mines in the anthracite region being composed of culm, on which no value was placed, this factor is not considered in the placing of the value on the total production.

The value of the bituminous product in 1903 exceeds that of 1902 by $60,829,450, or 21 per cent, and that of 1901 by $115,265,884, or nearly 50 per cent. The quantity of bituminous coal produced in 1903 exceeded that of 1901 by 56,921,199 short tons, or 25 per cent. As has been previously stated, in amount of production, and particularly in the greatly enhanced values, the coal mining industry was highly satisfactory to everybody concerned except consumers. In the nine years from 1894 to 1903 the production of coal in the United States has almost exactly doubled, while in eighteen years since 1886 it has more than trebled. The total coal production of the United States amounted to 100,000,000 short tons for the first time in 1882. In 1890, or eight years later, it exceeded a total production of 150,000,000 tons. Seven years later, in 1897, it had increased another 50,000,000, and reached a total of a little over 300,000,000 in 1902.

The gain of over 50,000,000 tons in 1903 is thus shown to have been equal to the total increase in the five years from 1887 to 1892, in the seven years from 1890 to 1897, and in the eight years from 1882 to 1890.

This great increase in the production of coal illustrates strikingly the industrial development of the United States. Going back for a period of a little over fifty years, or to the middle of the last century, and comparing the statistics of coal production with the increased population, it is found that in 1850, according to the United States census for that year, the production of coal amounted to 6,445,681 tons when the population of the country amounted to 23,191,876 persons. The per capita production of coal in that year is thus seen to have been 0.278 ton. In 1860, or ten years later, the population was 31,443,321 persons and the coal production amounted to 14,333,922 tons, or an average of 0.514 ton per person.

At the census of 1870 the population of the United States amounted to 38,558,371; the coal production in that year amounted to 36,806,560 short tons, a per capita average of 0.955 ton. Ten years later, when the population was 50,155,783, the coal output amounted to 76,157,945 short tons, or 1.52 tons per capita. In 1890 the population had grown to 62,622,250, an increase of 25 per cent over 1880, while the coal production had grown to 157,770,963 short tons, or a per capita output of 2.05 tons. At the taking of the Twelfth Census in 1900 the increase in population amounted to 21 per cent, the total number of persons reported being 76,303,387, while more than 70 per cent had been added to the coal production, with a total of 269,684,027 short tons, or an average of 3.53 for each inhabitant. In other words, while the population from 1850 to 1900 has shown an increase of 230 per cent, the production of coal has increased 4,084 per cent. Estimating the population of the United States in 1903 to be 81,000,000 people, the per capita production for that year is found to be 4.4 tons.

Of the thirty States and Territories in which coal was produced in 1903 there were twenty-seven in which the coal production increased, and three in which a decrease was shown. The most notable increase outside of that made in the production of Pennsylvania anthracite, was the gain shown by West Virginia, whose production increased 4,766,415 tons. The Pennsylvania bituminous production increased 4,542,811 tons and Illinois showed an increase of 4,017,731 tons. The three States in which decreases were shown were North Carolina, Maryland, and Montana.

Since 1889 the United States has stood at the head of the coal-producing countries of the world, the output in 1903 being equal to 37 per cent of the entire world's production. It exceeds that of Great Britain, which stands second, by 99,381,811 short tons, or 38.5 per cent, and was almost double that of Germany, which stands third as a coal producer.

The production of bituminous coal by the use of undercutting machines continued to show an increase in somewhat greater proportion than the increase in the total bituminous tonnage. The statistics for 1903 show that during that year there were 6,658 undercutting machines in use, as compared with 5,418 machines in 1902, 4,341 in 1901, and 3,907 in 1900. The total production by the use of machines in 1903 amounted to 77,974,894 short tons, against 69,611,582 tons in 1902, and 57,843,335 tons in 1901, and 52,784,523 tons in 1900. The percentage of the machine-mined product to the total in the States in which mining machines were used, has increased from 25.15 in 1900 to 25.68 in 1901, to 27.09 in 1902, and to 28.18 in 1903. Of the total number of machines in use in 1903, 3,887 were of the pick or "puncher" type, 2,717 were chain breast, and 54 were long wall. The largest number of both pick and chain machines were in use in Pennsylvania, while more than 50 per cent of the total number of longwall machines in use were employed in the mines of Missouri.

The statistics of labor employed in 1903 show that the total number of employees in the coal mines of the United States of that year were 566,260 men and boys, who worked an average of 220 days. In 1902 there were 518,200 men employed for an average of 197 days, while in 1901 the number of men employed was 485,544 and the average working time was 216 days. The number of men employed in the anthracite mines in 1903 was 150,483, and in the bituminous mines the number of employees amounted to 415,777. The average working time in the anthracite mines was 206 and in the bituminous mines 225 days. In 1902 the number of men employed in the anthracite mines was 148,141, and the average working time was 116 days. The number of men employed in the bituminous mines in 1902 was 370,059; the average working time was 230 days. The average working time in the anthracite coal mines of Pennsylvania is considerably less than that made by the bituminous miners. During the last six years the average working time among the anthracite mines has been less than 180 days, while in the bituminous mines the average has been something more than 225. The best records made in the anthracite mines during the last ten years were in 1895 and 1901, when the men averaged 196 days, and in 1903 when an average of 206 days was made. In the bituminous mines the best records were made in 1899 and 1900, in each of which years the average was 234 days.

Nearly the entire output of both anthracite and bituminous coal of the United States is consumed within the country. The total exports in 1903 amounted to 9,309,550 short tons, which, deducted from the production of 357,356,416 tons, shows the domestic consumption to have amounted to 348,046,866 short tons. If to this are added the imports, which in 1903 amounted to 3,885,650 short tons, the total consumption of coal in the United States, eliminating the stocks on hand, is shown to have been 351,932,516 short tons.

In considering the coal product of the United States these reports include not only the coal marketed either by shipment to distant points or sold locally, but that consumed by mine employees and by the mine owners in the operation of the collieries. The latter factor is usually considered and reported as colliery consumption. There are occasional exceptions in the bituminous fields where operators, who use only slack, an otherwise waste product, do not report this item in their statement of production, and do not consider it of any value; it is not considered as a portion of the mine product nor is the miner paid for it in wages. Such exceptions are few and the amount is negligible. The amount of coal consumed in the manufacture of coke is also considered in this report. This amounted in 1903 to 33,801,418 short tons, a slight decrease compared with 1902, when the amount made into coke was 34,169,730 short tons. The coal shipped to market, used in the manufacture of coke, and sold locally, which are considered as the marketable product, amounted in 1903 to 344,722,763 short tons, as compared with 291,594,578 in 1902. 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. In 1902 the proportion was somewhat larger than usual on account of the amount of coal used in keeping the fans and pumps in operation during the strike while the mines were idle. About 12 per cent of the anthracite total product in 1902 was used for this purpose. In the bituminous mines the amount used for colliery consumption averaged between 1½ and 2 per cent of the total product.

The statistics of the production of coal in the United States in 1902 and 1903, by States, with the distribution of the product for consumption, the total value, and the statistics of the labor employed, are shown in the following tables:

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	65,881	....	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	795
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

Coal production of the United States in 1902, 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.*				
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	2,844
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	290,358,483	1.12	230	370,059
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	518,200

Coal production of the United States in 1903, 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.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Alabama	8,347,507	138,201	305,269	2,863,347	11,654,324
Arkansas	2,142,988	20,408	65,776	....	2,229,172
California and Alaska	83,339	7,555	14,526	....	105,420
Colorado	5,618,833	243,312	188,565	1,372,892	7,423,602
Georgia and North Carolina	281,798	899	5,011	146,552	434,260
Idaho	3,000	1,150	100	....	4,250
Illinois	32,911,291	2,785,473	1,232,204	28,136	36,957,104
Indiana	9,827,374	639,925	324,138	3,255	10,794,692
Indian Territory	3,329,610	32,610	78,995	76,173	3,517,388
Iowa	5,379,251	887,745	152,815	....	6,419,811
Kansas	5,509,846	229,585	96,834	3,711	5,839,976
Kentucky	6,805,323	380,449	159,589	192,671	7,538,032
Maryland	4,752,716	53,022	40,427	....	4,846,165
Michigan	1,203,166	123,677	40,776	....	1,367,619
Missouri	3,814,688	300,101	123,797	....	4,238,586
Montana	1,287,322	50,904	63,428	87,156	1,488,810
New Mexico	1,414,183	24,609	40,276	62,713	1,541,781
North Dakota	214,671	59,913	4,061	....	278,645

Coal production of the United States in 1903, 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.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Ohio	23,098,792	1,367,494	375,742	1,075	24,838,103
Oregon	67,192	9,848	14,104		91,144
Pennsylvania	77,987,351	1,572,156	1,863,363	21,694,308	103,117,178
Tennessee	3,763,428	67,388	65,371	901,817	4,798,004
Texas	880,256	34,021	12,482		926,759
Utah	1,301,755	26,354	46,204	307,096	1,681,409
Virginia	1,623,077	30,153	56,611	1,741,466	3,451,307
Washington	2,978,819	38,541	100,748	75,165	3,193,273
West Virginia	24,056,649	584,927	473,780	4,221,885	29,337,241
Wyoming	4,371,611	47,761	193,921	22,000	4,635,293
Total bituminous	233,050,836	9,758,181	6,138,913	33,801,418	282,749,348
Pennsylvania anthracite	66,762,592	1,349,736	6,494,740		74,607,068
Grand total	299,813,428	11,107,917	12,633,653	33,801,418	357,356,416

State.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
Alabama	$14,246,798	$1.22	228	21,438
Arkansas	3,360,831	1.51	223	4,157
California and Alaska	301,318	2.86	301	206
Colorado	9,150,943	1.23	245	9,229
Georgia and North Carolina	546,759	1.26	296	730
Idaho	13,250	3.10	197	32
Illinois	43,196,809	1.17	228	50,596
Indiana	13,244,817	1.23	197	17,017
Indian Territory	6,386,463	1.82	247	7,704
Iowa	10,563,910	1.65	226	14,162
Kansas	8,871,953	1.52	215	10,924
Kentucky	7,979,342	1.06	207	14,354
Maryland	7,189,784	1.48	219	5,859
Michigan	2,707,527	1.97	222	2,768
Missouri	6,834,297	1.61	215	9,544
Montana	2,440,846	1.64	254	2,156
New Mexico	2,105,785	1.37	260	1,799
North Dakota	418,005	1.50	198	486
Ohio	31,932,327	1.29	194	41,936
Oregon	221,031	2.43	258	235
Pennsylvania	121,752,759	1.18	235	129,265
Tennessee	5,979,830	1.25	227	9,961
Texas	1,505,388	1.62	242	2,390
Utah	2,026,038	1.20	248	1,925
Virginia	3,302,149	.96	267	5,608
Washington	5,380,679	1.69	285	4,768
West Virginia	34,297,019	1.17	210	41,554
Wyoming	5,731,281	1.24	252	4,993
Total bituminous	351,687,933	1.24	225	415,777
Pennsylvania anthracite	152,036,448	2.04	206	150,483
Grand total	503,724,381	1.41	220	566,260

In the following tables are shown the quantity and value of the coal produced in the United States during the last five years, with the increases and decreases in 1903 as compared with 1902:

Quantity and value of coal produced in the United States, 1899–1903.

State or Territory.	1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Alabama	7,593,416	$8,256,462	8,394,275	$9,793,785	9,099,052	$10,000,892
Arkansas	843,554	989,383	1,447,945	1,653,618	1,816,136	2,068,613
California and Alaska	162,172	447,436	172,908	540,031	152,379	409,706
Colorado	4,776,224	5,363,667	5,244,364	5,858,036	5,700,015	6,441,891
Georgia and North Carolina	260,007	268,309	333,291	393,469	354,825	426,685
Idaho	20	100	10	50	....	....
Illinois	24,439,019	20,744,553	25,767,981	26,927,185	27,331,552	28,163,937
Indiana	6,006,523	5,285,018	6,484,086	6,687,137	6,918,225	7,017,143
Indian Territory	1,537,427	2,199,785	1,922,298	2,788,124	2,421,781	3,915,268
Iowa	5,177,479	6,397,338	5,202,939	7,155,341	5,617,499	7,822,805
Kansas	3,852,267	4,478,112	4,467,870	5,454,691	4,900,528	5,991,599
Kentucky	4,607,255	3,618,222	5,328,964	4,881,577	5,469,986	5,213,076
Maryland	4,807,396	3,667,056	4,024,688	3,927,381	5,113,127	5,046,491
Michigan	624,708	870,152	849,475	1,259,683	1,241,241	1,753,064
Missouri	3,025,814	3,591,945	3,540,103	4,280,328	3,802,088	4,707,164
Montana	1,496,451	2,347,757	1,661,775	2,713,707	1,396,081	2,009,316
New Mexico	1,050,714	1,461,865	1,299,299	1,776,170	1,086,546	1,546,652
North Dakota	98,809	117,500	129,883	158,348	166,601	214,151
Ohio	16,500,270	14,361,903	18,988,150	19,292,246	20,943,807	20,928,158
Oregon	86,888	260,917	58,864	220,001	69,011	173,646
Pennsylvania:						
Anthracite	60,418,005	88,142,130	57,367,915	85,757,851	67,471,667	112,504,020
Bituminous	74,150,175	56,247,791	79,842,326	77,438,545	82,305,946	81,397,586
Tennessee	3,330,659	2,940,644	3,509,562	4,003,082	3,633,290	4,067,389
Texas	883,832	1,334,895	968,373	1,581,914	1,107,953	1,907,024
Utah	786,049	997,271	1,147,027	1,447,750	1,322,614	1,666,082
Virginia	2,105,791	1,304,241	2,393,754	2,123,222	2,725,873	2,353,989
Washington	2,029,881	3,603,989	2,474,093	4,700,068	2,578,217	4,271,076
West Virginia	19,252,995	12,053,268	22,647,207	18,416,871	24,068,402	20,848,184
Wyoming	3,837,392	4,742,525	4,014,602	5,457,953	4,485,374	6,060,462
Total	253,741,192	256,094,234	269,684,027	306,688,164	293,299,816	348,926,069

Quantity and value of coal produced in the United States, 1899–1903—Continued.

State or Territory.	1902.		1903.		Increase, 1903.		Per cent of increase.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*			
Alabama	10,354,570	$12,419,666	11,654,324	$14,246,798	1,299,754	$1,827,132	12.6	14.7
Arkansas	1,943,932	2,539,214	2,229,172	3,360,831	285,240	821,617	14.7	32.4
California and Alaska	87,196	273,398	105,420	301,318	18,224	27,920	20.9	10.2
Colorado	7,401,343	8,397,812	7,423,602	9,150,943	22,259	753,131	.3	9.0
Georgia and North Carolina	437,083	623,518	434,260	546,759	a 2,823	a 76,759	a .6	a 12.3
Idaho	2,030	5,180	4,250	13,250	2,220	8,070	109.3	155.8
Illinois	32,939,373	33,945,910	36,957,104	43,196,809	4,017,731	9,250,899	12.2	27.3
Indiana	9,446,424	10,399,660	10,794,692	13,244,817	1,348,268	2,845,157	14.3	27.4
Indian Territory	2,820,666	4,265,106	3,517,388	6,386,463	696,722	2,121,357	24.7	49.7
Iowa	5,904,766	8,660,287	6,419,811	10,563,910	515,045	1,903,623	8.7	22.0
Kansas	5,266,065	6,862,787	5,839,976	8,871,953	573,911	2,009,166	10.9	29.3
Kentucky	6,766,984	6,666,967	7,538,032	7,979,342	771,048	1,312,375	11.4	19.7
Maryland	5,271,609	5,579,869	4,846,165	7,189,784	a 425,444	1,609,915	a 8.07	29.0
Michigan	964,718	1,653,192	1,367,619	2,707,527	402,901	1,054,335	41.8	63.8
Missouri	3,890,154	5,374,642	4,238,586	6,834,297	348,432	1,459,655	9.0	27.2
Montana	1,560,823	2,443,447	1,488,810	2,440,846	a 72,013	a 2,601	a 4.6	a .1
New Mexico	1,048,763	1,500,230	1,541,781	2,105,785	493,018	605,555	47.0	40.4
North Dakota	226,511	325,967	278,645	418,005	52,134	92,038	23.0	28.2
Ohio	23,519,894	26,953,789	24,838,103	31,932,327	1,318,209	4,978,538	5.6	18.5
Oregon	65,648	160,075	91,144	221,031	25,496	60,956	38.8	38.1
Pennsylvania:								
Anthracite	41,373,595	76,173,586	74,607,068	152,036,448	33,233,473	75,862,862	80.3	99.6
Bituminous	98,574,367	106,032,460	103,117,178	121,752,759	4,542,811	15,720,299	4.6	14.8
Tennessee	4,382,968	5,399,721	4,798,004	5,979,830	415,036	580,109	9.5	10.7
Texas	901,912	1,477,245	926,759	1,505,383	24,847	28,138	2.8	1.9
Utah	1,574,521	1,797,454	1,681,409	2,026,038	106,886	228,584	6.8	12.7
Virginia	3,182,993	2,543,595	3,451,307	3,302,149	268,314	758,554	8.4	29.8
Washington	2,681,214	4,572,295	3,193,273	5,380,679	512,059	808,384	19.1	17.7
West Virginia	24,570,826	24,748,658	29,337,241	34,297,019	4,766,415	9,548,361	19.3	38.6
Wyoming	4,429,491	5,236,339	4,635,293	5,731,281	205,802	494,942	4.6	9.5
Total	301,590,439	367,032,069	357,356,416	503,724,381	55,765,977	136,692,312	18.5	37.2

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 1903, a period of twenty-four years. It is interesting to note, in this table, the comparatively rapid growth of the bituminous or soft coal production beside that of anthracite. It is seen that while the production of anthracite has increased from 25,580,189 long tons in 1880 to 66,613,454 long tons in 1903, a gain of 41,033,265 long tons, or 160 per cent, the bituminous production has grown from 47,508,133 short tons in 1880 to 282,749,348 tons in 1903, an increase of 245,241,215 short tons, or a little over 495 per cent. Notwithstanding the abnormally large production of 1903, it does not appear that the anthracite production will exhibit any pronounced increase in the future. The conditions under which the mines are operated and the increasing cost of labor are making the use of anthracite slowly but surely more and more of a luxury. As prices have necessarily advanced, and as any permanent decline in price is not anticipated to occur, the use of other fuels as a substitute for anthracite coal will naturally increase. At one time an important factor in blast furnace use and other manufacturing industries, the use of anthracite coal for such purposes has now almost entirely ceased. The preparation of what are known as the domestic sizes—that is, egg, stove, and chestnut—results in the production of a greater proportion of the small or undesirable sizes, which are usually sold at less than the cost of production. The profits must therefore all be obtained from the prepared domestic sizes, and no encouragement can be offered to the consumers of anthracite that their fuel bills in the future will be decreased. A policy of the anthracite operators, adopted during recent years, of making an allowance of 50 cents per ton from circular prices for coal purchased in April of each year, with an advance of 10 cents per ton for each succeeding month until the schedule price is reached in September, has had a better influence in steadying the anthracite trade than almost any other action taken in the past. It encourages the storage of coal in the cellars of consumers and causes the mines to be operated more regularly and gives more steady employment to employees throughout the year.

Annual production of coal in the United States, 1880–1903.

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	42,417,976	47,508,133	$58,443,718
1881	28,500,016	31,920,018	64,125,036	48,179,475	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	65,021,269	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	131,801,356	147,617,519	119,595,224
1898	47,663,076	53,382,644	75,414,537	148,744,806	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	189,567,957	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
1903	66,613,454	74,607,068	152,036,448	252,454,775	282,749,348	351,687,933

Annual production of coal in the United States, 1880–1903—Continued.

Year.	Total.		
	Quantity.		Value.
	Long tons.	*Short tons.*	
1880	67,998,165	76,157,945	$95,640,396
1881	76,679,491	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	99,249,817	111,159,795	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	168,566,669	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	178,776,070	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	240,789,310	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
1903	319,068,229	357,356,416	503,724,381

The statistics regarding the distribution of the coal production of the United States for consumption have been obtained only since 1889. These are shown in the following table, together with the value of the product, the statistics of labor employed, and the average working time made by mine employees.

Distribution of the coal product of the United States, 1889–1903.

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	128,365,965	9,009,285	5,063,953	15,331,760
1891	137,920,346	8,871,882	6,056,001	15,718,440
1892	146,372,098	9,704,678	6,210,767	17,041,528
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	208,751,746	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	28,314,150
1902	247,642,852	9,781,996	9,995,861	34,169,730
1903	299,813,428	11,107,917	12,633,653	33,801,418

Distribution of the coal product of the United States, 1889–1903—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	157,770,963	176,804,573	1.12	216	318,204
1891	168,566,669	191,133,135	1.13	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
1903	357,356,416	503,724,381	1.41	220	566,250

RANK OF COAL-PRODUCING STATES.

In the following tables the coal-producing States are arranged according to the rank in 1902 and 1903, first in the amount of production, and then in the value of the product, with the amount and percentage of both quantity and value contributed by each State. The first six States, so far as the amount of production is concerned, retain the same relative positions in 1903 as in 1902. Kentucky succeeds Colorado as seventh in rank, while Kansas has supplanted Maryland in tenth place. West Virginia, which for several years has outranked Ohio in the quantity of coal production, exceeded the value of Ohio's production for the first time in 1903, and takes third place in this regard. The other ten leading States retain the same position in 1903 as in 1902:

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	20.8
	Bituminous	98,574,367	32.7		Bituminous	106,032,460	28.9
2	Illinois	32,939,373	10.9	2	Illinois	33,945,910	9.2
3	West Virginia	24,570,826	8.2	3	Ohio	26,953,789	7.3
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	3.4
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	1.9
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	1.5
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	Virginia	2,543,595	.7
18	Arkansas	1,943,932	.6	18	Arkansas	2,539,214	.7
19	Utah	1,574,521	.5	19	Montana	2,443,417	.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	.5
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

Rank of coal-producing States in 1903, 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	74,607,068	20.9	1	Anthracite	$152,036,448	30.2
	Bituminous	103,117,178	28.9		Bituminous	121,752,759	24.2
2	Illinois	36,957,104	10.3	2	Illinois	43,196,809	8.6
3	West Virginia	29,337,241	8.2	3	West Virginia	34,297,019	6.8
4	Ohio	24,838,103	7.0	4	Ohio	31,932,327	6.3
5	Alabama	11,654,324	3.3	5	Alabama	14,246,798	2.8
6	Indiana	10,794,692	3.0	6	Indiana	13,244,817	2.6
7	Kentucky	7,538,032	2.1	7	Iowa	10,563,910	2.1
8	Colorado	7,423,602	2.1	8	Colorado	9,150,943	1.8
9	Iowa	6,419,811	1.8	9	Kansas	8,871,953	1.8
10	Kansas	5,839,976	1.6	10	Kentucky	7,979,342	1.6
11	Maryland	4,846,165	1.4	11	Maryland	7,189,784	1.4
12	Tennessee	4,798,004	1.3	12	Missouri	6,834,297	1.3
13	Wyoming	4,635,293	1.3	13	Indian Territory	6,386,463	1.3
14	Missouri	4,238,586	1.2	14	Tennessee	5,979,830	1.2
15	Indian Territory	3,517,388	1.0	15	Wyoming	5,731,281	1.1
16	Virginia	3,451,307	.9	16	Washington	5,380,679	1.1
17	Washington	3,193,273	.9	17	Arkansas	3,360,881	.7
18	Arkansas	2,229,172	.6	18	Virginia	3,302,149	.7
19	Utah	1,681,409	.5	19	Michigan	2,707,527	.5
20	New Mexico	1,541,781	.4	20	Montana	2,440,846	.5
21	Montana	1,488,810	.4	21	New Mexico	2,105,785	.4
22	Michigan	1,367,619	.4	22	Utah	2,026,038	.4
23	Texas	926,759	.3	23	Texas	1,505,388	.3
24	Georgia and North Carolina	434,260	.1	24	Georgia and North Carolina	546,759	.1
25	North Dakota	278,645	.1	25	North Dakota	418,005	.2
26	California and Alaska	105,420		26	California and Alaska	301,318	
27	Oregon	91,144		27	Oregon	221,031	
28	Idaho	4,250		28	Idaho	13,250	
	Total	357,356,416	100.0		Total	503,724,381	100.0

KINDS OF COAL PRODUCED IN THE UNITED STATES.

In the general discussion of the coal production of the United States only two divisions are considered, anthracite and bituminous, the latter product including the small anthracite output of Colorado and New Mexico. In the bituminous production, however, in addition to the small Rocky Mountain output of anthracite is also included the production of coals generally classed as semianthracite, semibituminous, cannel, block, splint, and lignite. In the following table the production of these various varieties of coal in 1902 and 1903 is reported as prepared from the schedules returned to the Survey. It should be stated, however, that this classification makes no claim to technical exactness. It has been compiled from the replies of the producers to the inquiry "Kind of coal produced" on the schedules, and such replies are in some minor cases based on quite uncertain knowledge. In fact, the varieties of the different coals grade so imperceptibly from one to another that no exact separation is possible. It is believed, however, that in this classification the quantity of each kind of coal produced is approximately indicated. It is sufficiently correct for practical purposes, and shows that in addition to the anthracite production of Pennsylvania there were 42,139 short tons mined in Colorado and that 30,592 short tons were produced in New Mexico. Semianthracite coal was produced in Pennsylvania, Colorado, Tennessee, Indian Territory, Virginia, and Arkansas, the latter State being credited with nearly 80 per cent of the total. There were sixteen States in which semibituminous coal was produced, West Virginia leading, Pennsylvania second, and Maryland third. These three States contributed 90 per cent of this variety. Wyoming leads in the production of lignite, with Colorado second and New Mexico third. West Virginia is credited with nearly the entire product of splint coal, and Indiana with that of block. The production of cannel coal is largely limited to West Virginia and Kentucky, each producing about the same quantity, the total for the two States amounting to 80 per cent of the total of this variety.

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	10,051
Wyoming	1,448,634		207,642	2,772,015
Tennessee	4,382,968			
Missouri	3,889,558			
Virginia	2,498,283		664,398	
Indian Territory	2,232,042			
Washington	2,055,208		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

Classification of the coal product of the United States in 1902, by States and Territories—Continued.

State or Territory.	Bituminous.	Anthracite.	Semibituminous.	Lignite.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
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

State or Territory.	Semi-anthracite.	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] 65,817	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	279,876	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.

Classification of the coal product of the United States in 1903, by States and Territories.

State or Territory.	Bituminous.	Anthracite.	Semibituminous.	Lignite.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*
Pennsylvania	99,734,819	74,607,068	3,332,564	....
Illinois	36,855,262	....	94,746	....
West Virginia	22,321,486	....	4,582,454	....
Ohio	24,803,084	....	....	....
Alabama	11,600,436	....	53,888	....
Indiana	9,569,953	....	9,794	....
Kentucky	7,359,994	....	....	....
Colorado	5,981,394	42,139	298,153	1,107,513
Iowa	6,341,487	....	....	....
Kansas	5,809,828	....	4,281	1,017
Maryland	2,982,533	....	1,863,632	....
Tennessee	4,749,587	....	....	....
Wyoming	1,257,917	....	261,058	3,116,318
Missouri	4,237,886	....	....	....
Indian Territory	3,271,298	....	....	....
Virginia	2,657,709	....	764,056	....
Washington	2,727,245	....	7,107	458,921
Arkansas	853,972	....	27,204	3,000
Utah	1,680,681	....	728	....
New Mexico	940,067	30,592	1,760	569,362
Montana	1,480,285	....	....	7,875
Michigan	1,331,570	....	....	....
Texas	659,154	....	....	267,606
Georgia	416,951	....	....	....
North Dakota	28,315	....	....	250,330
California	1,000	....	2,600	101,073
Oregon	....	....	560	[a] 90,584
North Carolina	17,309	....	....	....
Idaho	500	....	....	3,750
Alaska	700	....	....	47
Total	259,622,417	74,679,799	11,254,584	5,977,396

[a] Includes 50,791 tons of semilignite coal.

Classification of the coal product of the United States in 1903, by States and Territories—Continued.

State or Territory.	Semi-anthracite.	Block.	Splint.	Cannel.	Total.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Pennsylvania	48,641			1,154	177,724,246
Illinois		7,096			36,957,104
West Virginia			2,347,238	[a] 136,063	29,337,241
Ohio		8,979	26,040		24,838,103
Alabama					11,654,324
Indiana		[b] 1,179,045		35,900	10,794,692
Kentucky		35,032	5,000	[c] 138,006	7,538,032
Colorado	44,403				7,423,602
Iowa		58,703		19,621	6,419,811
Kansas		24,850			5,839,976
Maryland					4,846,165
Tennessee	48,417				4,798,004
Wyoming					4,635,293
Missouri				700	4,238,586
Indian Territory	246,095				3,517,388
Virginia	29,543				3,451,307
Washington					3,193,273
Arkansas	1,344,996				2,229,172
Utah					1,681,409
New Mexico					1,541,781
Montana				650	1,488,810
Michigan		36,049			1,367,619
Texas					926,759
Georgia					416,951
North Dakota					278,645
California					104,673
Oregon					91,144
North Carolina					17,309
Idaho					4,250
Alaska					747
Total	1,762,095	1,349,754	2,378,278	332,094	357,356,416

[a] Includes 122,049 tons of semicannel coal.
[b] Includes 177,357 tons of semiblock coal.
[c] Includes 19,390 tons of semicannel coal.

LABOR STATISTICS.

The following tables show the number of men employed and the average number of days made by each for the last five years, by States, and the total number of men employed in the anthracite and bituminous coal mines of the United States, with the average working time since 1890:

Statistics of labor employed in coal mines of the United States, 1899–1903, by States.

State or Territory.	1899.		1900.		1901.	
	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
Arkansas	156	2,818	219	2,800	223	3,144
California	a 287	369	309	378	289	428
Colorado	246	7,166	264	7,459	253	8,870
Georgia	b 291	637	b 262	681	b 291	791
Idaho	....	....	....	....	....	....
Illinois	228	36,756	226	39,101	220	41,880
Indiana	218	9,712	199	11,720	194	12,968
Indian Territory	212	4,084	228	4,525	208	6,706
Iowa	229	10,971	228	11,608	218	12,663
Kansas	226	8,000	232	8,459	224	9,928
Kentucky	224	7,461	227	9,680	213	10,307
Maryland	275	4,624	203	5,319	262	5,333
Michigan	232	1,291	261	1,709	247	2,276
Missouri	212	7,136	214	8,180	223	9,871
Montana	238	2,378	252	2,376	231	2,156
New Mexico	257	1,750	261	2,037	224	2,478
North Dakota	154	210	142	326	198	280
Ohio	200	26,038	215	27,628	198	32,111
Oregon	238	124	273	141	228	187
Pennsylvania bituminous	245	82,812	242	92,692	230	101,904
Tennessee	252	6,949	242	7,646	228	9,046
Texas	256	2,410	246	2,844	264	3,051
Utah	265	743	246	1,308	259	1,712
Virginia	252	1,960	239	3,631	279	4,152
Washington	259	3,330	289	3,670	276	4,545
West Virginia	242	23,625	231	29,163	219	30,935
Wyoming	261	4,697	266	5,332	248	5,151
Total	234	271,027	234	304,380	225	340,235
Pennsylvania anthracite	173	139,608	166	144,206	196	145,309
Grand total	214	410,635	212	448,581	216	485,544

a Includes Alaska. b Includes North Carolina.

Statistics of labor employed in coal mines of the United States, 1899–1903—Continued.

State or Territory.	1902.		1903.	
	Number of days active.	Average number employed.	Number of days active.	Average number employed.
Alabama	256	16,439	228	21,438
Arkansas	188	3,595	223	4,157
California	a 302	a 217	a 301	a 208
Colorado	261	8,956	246	9,229
Georgia	b 312	b 795	b 296	b 730
Idaho	74	20	197	32
Illinois	226	47,411	228	50,596
Indiana	205	15,457	197	17,017
Indian Territory	232	5,574	247	7,704
Iowa	227	12,434	226	14,162
Kansas	220	9,461	215	10,924
Kentucky	209	13,727	207	14,354
Maryland	242	5,827	219	5,859
Michigan	171	2,344	222	2,768
Missouri	202	9,742	215	9,544
Montana	270	1,938	254	2,155
New Mexico	217	1,849	260	1,789
North Dakota	213	402	198	486
Ohio	200	38,965	194	41,936
Oregon	234	265	258	235
Pennsylvania bituminous	248	112,630	235	129,265
Tennessee	230	8,750	227	9,961
Texas	267	2,369	242	2,380
Utah	259	1,826	248	1,925
Virginia	293	3,912	267	5,608
Washington	275	4,404	285	4,768
West Virginia	205	35,500	210	41,554
Wyoming	248	5,250	252	4,993
Total	230	370,059	225	415,777
Pennsylvania anthracite	116	148,141	206	150,483
Grand total	197	518,200	220	566,260

a Includes Alaska. b Includes North Carolina.

By the terms of the award of the Anthracite Coal Strike Commission the anthracite coal mines of Pennsylvania were placed upon a 9-hour basis for all company men or those working by the day, with the exception of hoisting engineers, other engineers, and pump men, who were allotted 8 hours for a day's work. The returns from the bituminous coal producing States in 1903 show that in the majority of cases 9 hours constitutes the average day's work. There were 14 bituminous coal producing States in which 9 hours was reported as the average day. These were: Alabama, California, Colorado, Idaho, Kansas, Kentucky, New Mexico, Oregon, Pennsylvania, Tennessee, Texas, Utah, Washington, and West Virginia. There were 9 States in which 8 hours was reported as the average working time. These States were: Arkansas, Illinois, Indiana, Indian Territory, Iowa, Michigan, Missouri, Montana, and Ohio. The 10-hour days prevailed in 6 States, viz: Georgia, Maryland, North Carolina, North Dakota, Virginia, and Wyoming.

Statistics of labor employed in coal mines of the United States, 1890–1903, by years.

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
1903	206	150,483	225	415,777

From the statistics contained in the preceding tables, and the totals of production in the earlier pages of this report, the following statement showing the average annual and daily tonnage per man since 1890 has been compiled. This table shows that in 1890 the average annual production per man employed in the anthracite region was 369 short tons. The average tonnage per man per day was 1.85 tons. In the bituminous and lignite regions the average production per man for the year was 579 short tons, and 2.56 short tons per man per day. In 1903 the average production per man in the anthracite region was 496 tons for the year and 2.41 short tons per day, while the bituminous production shows an average of 680 tons per man for the year, and 3.02 short tons per day. This table is further interesting in showing that, whereas since 1897 the average tonnage per man per day in the anthracite region has varied between 2.34 and 2.50, from 1890 to 1896, inclusive, the average daily tonnage per man was between 1.85 and 2.10. The average tonnage per man per year during the later period has not shown any increase over the earlier period. In the bituminous production on the other hand the statistics show an increase both in daily and annual production per man in the latter half of the period as compared with the earlier half.

Production of coal according to number of persons employed, 1890–1903.

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
1903	150,483	206	2.41	496	415,777	225	3.02	680

While there are a few exceptions to the rule, it generally appears that there has been an increased production, both per day and per year, for each man employed where there has been an increase in the machine-mined tonnage. In Colorado, for instance, on account of labor troubles the total tonnage per man for the year decreased from 826 tons in 1902 to 804.4 tons in 1903. The daily tonnage per man increased from 3.16 tons to 3.28 tons, and the quantity produced increased from 857,279 tons to 1,270,221 tons, and the percentage of machine-mined tonnage increased from 11.58 to 17.11. In Indiana the yearly tonnage per man increased from 611.1 tons to 634.3 tons. The daily tonnage per man increased from 2.98 to 3.22 tons, and the machine-mined output increased from 2,421,342 short tons to 3,334,961 short tons. The percentage of the machine-mined product to the total increased from 25.63 to 30.9. In the Indian Territory, on the other hand, there was a decrease from 506 tons to 457 tons in the yearly tonnage per man, and from 2.18 to 1.85 tons in the average daily output; while the machine-mined production declined from 119,195 tons to 73,304 tons, and the percentage of machine-mined production to the total fell off from 4.23 to 2.08. Similar decreases were shown in the yearly and daily tonnage per man in Iowa and Kansas, while the machine-mined production and the percentage of machine-mined coal to the total production also decreased. An exception is noted in Kentucky, where the average tonnage per year per man increased from 493 tons to 525.2 tons, and the daily tonnage per man from 2.35 to 2.54 tons, while the tonnage mined by machines decreased from 3,091,626 short tons to 2,843,805 short tons, the percentage of machine-mined product to the total being 45.69 in 1902 and 37.73 in

1903. In Michigan the total production per man for the year increased, while the daily production decreased, the machine-mined production falling off from 196,248 short tons in 1902 to 180,943 tons in 1903. Missouri's production shows an increase in the average daily production per man, in the tonnage obtained by the use of machines and the percentage of machine-mined product to the total. Montana, on the contrary, with a slightly increased machine-mined tonnage, shows a falling off in both the yearly and daily tonnage per man. Ohio, because of a decrease in the average working time made during the year, shows a falling off in the average production per man per year, but an increase in the average production per man per day. The machine-mined tonnage of this State increased nearly 2,000,000 tons in 1903 over 1902, and the percentage of machine-mined product to the total increased from 51.42 to 56.39. Pennsylvania's machine-mined production also increased about 2,000,000 tons, but both the daily and yearly production per man decreased. In West Virginia there was a marked increase in the output of machine-mined coal and in the average yearly production per man, but a slight falling off in the productive efficiency per man per day. A most striking exception to the general rule was in the production of Alabama, where the machine-mined tonnage nearly doubled, while the average tonnage per man per year fell off from 630 tons in 1902 to 543 tons in 1903, and the daily production per man decreased from 2.46 to 2.38 tons. This apparent inconsistency was, without doubt, due to the labor troubles which affected the mining industry in that State during the early part of the year.

In the following table is presented a statement of the average yearly and daily production per man employed in each State during 1902 and 1903, together with the total tonnage mined by the use of machines in each State and the percentage of machine-mined tonnage to the total production.

Average production per man compared with production by machines in 1902 and 1903 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.	
	1902.	1903.	1902.	1903.	1902.	1903.	1902.	1903.
Alabama	630	543.6	2.46	2.38	300,670	577,317	2.90	4.95
Arkansas	540.7	536.2	2.88	2.40	8,989	....	.46	....
Colorado	826	804.4	3.16	3.28	857,279	1,270,221	11.58	17.11
Illinois	695	731	3.08	3.21	7,112,039	7,381,027	21.59	19.97
Indiana	611.1	684.3	2.98	3.22	2,421,342	3,334,961	25.63	30.90
Indian Territory	506	457	2.18	1.85	119,195	73,304	4.23	2.08
Iowa	475	453.3	2.09	2	110,489	55,085	1.87	.86
Kansas	556.6	534.6	2.53	2.49	48,000	9,876	.91	.17

Average production per man compared with production by machines in 1902 and 1903 by States—Continued.

State.	Average tonnage.				Production by machines.			
	Per year.		Per day.		Total tonnage by machines.		Per cent of machine coal to total.	
	1902.	1903.	1902.	1903.	1902.	1903.	1902.	1903.
Kentucky	493	525.2	2.35	2.54	3,091,626	2,843,805	45.69	37.78
Maryland	904.6	827.1	3.74	3.78	252,753	401,144	4.28	8.28
Michigan	411.6	494.1	2.40	2.23	196,248	180,943	20.34	13.23
Missouri	399.5	444.1	1.98	2.07	223,969	311,602	5.76	7.35
Montana	805	691	2.98	2.72	691,669	693,504	44.31	46.58
New Mexico	567	862	2.61	3.31	71,744	105,000	6.84	9.40
North Dakota	563.5	578.3	2.65	2.90	89,838	115,222	39.66	41.85
Ohio	604	592	3.02	3.05	12,094,641	14,007,326	51.42	56.39
Pennsylvania:								
Anthracite	278.7	495.8	2.04	2.41	....	....	....	....
Bituminous	875	798	3.52	3.40	35,058,038	37,146,253	35.57	36.02
Tennessee	501	482	2.18	2.12	303,995	304,602	6.94	6.35
Texas	381	389	1.43	1.61	25,500	29,000	2.83	3.13
Utah	862	873	3.33	3.52	74,502	75,000	4.81	4.46
Virginia	814	615	2.78	2.30	132,709	82,040	4.17	2.38
Washington	609	670	2.22	2.35	....	....	....	....
West Virginia	692	706	3.38	3.36	5,733,045	8,193,840	23.35	27.93
Wyoming	843.7	928.4	3.40	3.68	588,302	783,822	13.10	16.91

PRICES.

The following tables show the fluctuations in the average prices prevailing in each State since 1899, 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 1899.

[Per short ton.]

State or Territory.	1899.	1900.	1901.	1902.	1903.
Alabama	$1.09	$1.17	$1.10	$1.20	$1.22
Arkansas	1.17	1.14	1.14	1.31	1.51
California	a 2.76	a 3.12	a 2.65	a 3.14	a 2.86
Colorado	1.12	1.12	1.13	1.13	1.23
Georgia	1.00	1.17	1.20	b 1.42	b 1.26
Idaho	5.00	5.00	....	c 2.50	3.10
Illinois	.85	1.04	1.03	1.03	1.17
Indiana	.88	1.03	1.01	1.10	1.23
Indian Territory	1.43	1.45	1.62	1.51	1.82
Iowa	1.24	1.38	1.39	1.47	1.65
Kansas	1.16	1.22	1.22	1.30	1.52
Kentucky	.79	.92	.95	.99	1.06

a Includes Alaska. b Includes North Carolina. c Includes Nebraska.

Average prices for coal at the mines since 1899—Continued.

State or Territory.	1899.	1900.	1901.	1902.	1903.
Maryland	\$0.76	\$0.98	\$0.99	\$1.06	\$1.48
Michigan	1.39	1.48	1.41	1.71	1.97
Missouri	1.20	1.21	1.24	1.38	1.61
Montana	1.57	1.63	1.44	1.65	1.64
New Mexico	1.39	1.37	1.42	1.43	1.37
North Carolina	1.30	1.32	1.25	(a)	(a)
North Dakota	1.19	1.22	1.29	1.44	1.50
Ohio	.87	1.02	1.00	1.14	1.29
Oregon	3.00	3.74	2.52	2.44	2.43
Pennsylvania bituminous	.76	.97	.99	1.08	1.18
Tennessee	.88	1.14	1.12	1.23	1.25
Texas	1.51	1.63	1.72	1.64	1.62
Utah	1.27	1.26	1.26	1.14	1.20
Virginia	.62	.89	.86	.80	.96
Washington	1.78	1.90	1.66	1.72	1.69
West Virginia	.63	.81	.87	1.01	1.17
Wyoming	1.24	1.36	1.35	1.18	1.24
Total bituminous	.87	1.04	1.04	1.12	1.24
Pennsylvania anthracite	1.46	1.49	1.67	1.84	2.04
General average	1.01	1.14	1.19	1.22	1.41

a Included in Georgia.

Average price per short ton of coal in United States for 24 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	1903	2.04	1.24

COAL MINED BY MACHINES.

The machine-mined production of bituminous coal continues to show a decidedly increasing tendency, and the percentage of the total product produced by machines has also increased. The total production of machine-mined coal in 1903 amounted to 77,974,894 short tons, as compared with 69,611,582 short tons in 1902, an increase of 8,363,312 short tons, or 12 per cent. In 1902, 27.09 per cent of the bituminous product in States where machines are installed was mined by machines, while in 1903 the machine-mined product amounted to 28.18 per cent of the total. The total number of machines reported as in use in 1903 was 6,658, as compared with 5,418 in 1902, an increase of 1,240, or 22.9 per cent, as compared with the increase of 12 per cent in the machine-mined product. This would indicate that a number of machines were installed during the latter part of the year, and did not add materially to the production. Of the 6,658 machines in use in 1903, 3,887 were of the pick, or "puncher," type, 2,717 were of the chain-breast variety, and 54 were long-wall machines. Nearly 50 per cent of the total machine-mined product was reported from Pennsylvania, the number of machines in use in this State being 3,310, and the machine-mined product 37,146,253 short tons. West Virginia reported 788 machines in use and a machine-mined product of 8,193,840 short tons, while Ohio, with 724 machines, produced 14,007,326 short tons of machine coal. Illinois, with 553 machines in use, reported a total machine-mined product of 7,381,027 tons, and Kentucky, with 308 machines, produced 2,843,805 short tons. Ohio enjoys the distinction of the largest proportionate production by the use of machines, this State having in 1903 produced by machines 56.39 per cent of the total product mined, against 51.42 per cent in 1902. Montana reported 46.58 per cent mined by machines in 1903, and 44.31 per cent in 1902. Kentucky's machine-mined product decreased from 45.69 per cent in 1902 to 37.73 per cent in 1903, and the Illinois percentage decreased from 21.59 in 1902 to 19.97 in 1903. The percentage of machine-mined product to the total in Pennsylvania increased from 35.57 to 36.02, and West Virginia from 23.35 to 27.93. The statistics in regard to the coal mined by machines in the last five years are presented in the following tables, and show the number of machines in use in each State, 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 1899, 1900, 1901, 1902, and 1903.

State.	Number of machines in use.				
	1899.	1900.	1901.	1902.	1903.
Alabama	53	54	82	66	98
Arkansas	16	20	20	7	....
Colorado	63	90	62	98	157
Illinois	440	430	464	508	553
Indiana	247	254	256	269	329
Indian Territory	74	58	47	23	36
Iowa	41	40	53	31	10
Kansas	3	3	4	6	5
Kentucky	189	239	237	318	308
Maryland	8	10	15	25	36
Michigan	25	33	31	58	46
Missouri	9	15	24	20	33
Montana	75	81	70	65	68

Bituminous coal mined by machines in the United States in 1899, 1900, 1901, 1902, and 1903—Continued.

State.	Number of machines in use.				
	1899.	1900.	1901.	1902.	1903.
New Mexico	14	21	6	17	12
North Dakota	5	7	7	10	9
Ohio	278	341	376	559	724
Pennsylvania	1,848	1,786	2,058	2,620	3,310
Tennessee	22	18	21	38	51
Texas	....	....	8	8	8
Utah	....	....	13	13	13
Virginia	8	9	6	11	10
Washington	2	2	4	....	....
West Virginia	154	327	403	579	788
Wyoming	56	69	74	69	59
Total	3,125	3,907	4,841	5,418	6,658

State.	Number of tons mined by machines.				
	1899.	1900.	1901.	1902.	1903.
Alabama	260,444	370,150	289,051	300,670	577,317
Arkansas	146,899	219,065	102,220	8,989	....
Colorado	527,115	756,025	319,678	657,279	1,270,221
Illinois	6,065,312	5,083,594	5,774,639	7,112,039	7,381,027
Indiana	1,713,125	1,774,045	1,852,058	2,421,342	3,334,961
Indian Territory	276,180	239,424	177,238	119,195	73,304
Iowa	124,721	132,757	110,960	110,489	55,065
Kansas	40,271	46,164	37,979	48,000	9,876
Kentucky	1,625,809	2,339,944	2,254,711	3,091,626	2,843,806
Maryland	16,545	188,014	177,724	252,753	401,144
Michigan	64,055	191,577	177,969	196,248	180,943
Missouri	55,154	110,036	158,879	223,969	311,602
Montana	843,710	1,045,115	748,981	691,669	693,504
New Mexico	260,778	112,000	2,700	71,744	105,600
North Dakota	88,066	88,965	43,574	89,838	115,222
Ohio	6,822,524	8,835,743	9,908,316	12,094,641	14,007,826
Pennsylvania	22,000,722	26,867,058	29,591,368	35,058,088	37,146,253
Tennessee	208,033	176,872	220,573	308,995	304,602
Texas	....	....	22,420	25,500	29,000
Utah	....	....	14,738	74,502	75,000
Virginia	265,000	261,269	233,275	182,709	82,040
Washington	14,640	10,000	6,500	....	....
West Virginia	1,881,125	3,418,377	4,817,943	5,738,045	8,198,840
Wyoming	693,712	653,314	804,826	588,302	788,822
Total	43,963,935	52,784,523	57,843,335	69,611,582	77,974,894

Bituminous coal mined by machines in the United States in 1899, etc.—Continued.

State.	Total tonnage of States using mining machinery.				
	1899.	1900.	1901.	1902.	1903.
Alabama	7,593,416	8,394,275	9,099,052	10,354,570	11,654,324
Arkansas	843,554	1,477,945	1,816,136	1,943,932	....
Colorado	4,776,224	5,244,364	5,700,015	7,401,343	7,423,602
Illinois	24,439,019	25,767,981	27,331,552	32,939,373	36,957,104
Indiana	6,006,523	6,484,086	6,918,225	9,446,424	10,794,692
Indian Territory	1,537,427	1,922,298	2,421,781	2,820,666	3,517,388
Iowa	5,177,479	5,202,939	5,617,499	5,904,766	6,419,811
Kansas	3,852,267	4,467,870	4,900,528	5,266,065	5,839,976
Kentucky	4,607,255	5,328,964	5,469,986	6,766,984	7,538,032
Maryland	4,807,396	4,024,688	5,113,127	5,271,609	4,846,165
Michigan	624,708	849,475	1,241,241	964,718	1,367,619
Missouri	3,025,814	3,540,103	3,802,088	3,890,154	4,238,586
Montana	1,496,451	1,661,775	1,396,081	1,560,823	1,488,810
New Mexico	1,050,714	1,299,299	1,086,546	1,048,763	1,541,781
North Dakota	98,809	129,883	166,601	226,511	278,645
Ohio	16,500,270	18,988,150	20,943,807	23,519,894	24,838,103
Pennsylvania	74,150,175	79,842,326	82,305,946	98,574,367	103,117,178
Tennessee	3,330,659	3,708,562	3,633,290	4,382,968	4,798,004
Texas	....	....	1,107,953	901,912	926,759
Utah	....	....	1,322,614	1,574,521	1,681,409
Virginia	2,105,791	2,393,754	2,725,873	3,182,993	3,451,307
Washington	2,029,881	2,474,093	2,578,217	....	....
West Virginia	19,252,995	22,647,207	24,068,402	24,570,826	29,337,241
Wyoming	3,837,392	4,014,602	4,485,374	4,429,491	4,635,293
Total	191,144,219	209,864,639	225,251,934	256,943,673	276,691,829

State.	Percentage of total product mined by machines.				
	1899.	1900.	1901.	1902.	1903.
Alabama	3.43	4.41	3.17	2.90	4.95
Arkansas	17.41	14.82	5.62	.46	....
Colorado	11.03	14.42	5.60	11.58	17.11
Illinois	24.90	19.73	21.12	21.59	19.97
Indiana	28.52	27.36	26.77	25.63	30.90
Indian Territory	17.96	12.46	7.81	4.23	2.08
Iowa	2.21	2.55	1.97	1.87	.86
Kansas	1.04	1.03	.77	.91	.17
Kentucky	35.29	43.91	41.21	45.69	37.73
Maryland	.34	3.43	3.47	4.28	8.28
Michigan	10.20	22.55	14.33	20.34	13.23
Missouri	1.30	3.11	4.04	5.76	7.35
Montana	56.38	62.89	53.64	44.31	46.58
New Mexico	24.31	8.62	.24	6.84	9.40
North Dakota	38.52	26.15	26.15	39.66	41.35
Ohio	41.35	46.58	47.26	51.42	56.39
Pennsylvania	29.67	33.65	35.95	35.57	36.02
Tennessee	6.04	4.77	6.07	6.94	6.35
Texas	....	....	2.02	2.83	3.13
Utah	....	....	1.11	4.31	4.46
Virginia	23.06	9.66	8.55	4.17	2.38
Washington	.72	.40	.25	....	....
West Virginia	9.27	15.09	20.01	23.35	27.98
Wyoming	18.07	16.27	17.94	13.10	16.91
Average	23.00	25.15	25.68	27.09	28.18

The different kinds of machines in use in 1903, by States, are shown in the following table:

Number and kinds of machines in use in 1903.

State.	Pick.	Chain-breast.	Long-Wall.	Total.
Alabama	89	9	....	98
Colorado	88	65	4	157
Illinois	451	100	2	553
Indiana	110	219	....	329
Indian Territory	16	18	2	36
Iowa	....	....	10	10
Kansas	....	3	2	5
Kentucky	202	105	1	308
Maryland	36	....	....	36
Michigan	46	....	....	46
Missouri	4	....	29	33
Montana	61	2	....	63
New Mexico	....	12	....	12
North Dakota	2	7	....	9
Ohio	51	673	....	724
Pennsylvania	2,267	1,039	4	3,310
Tennessee	45	6	....	51
Texas	6	2	....	8
Utah	13	....	....	13
Virginia	....	10	....	10
West Virginia	358	430	....	788
Wyoming	42	17	....	59
Total	3,887	2,717	54	6,658

LABOR TROUBLES.

The year 1903 was one of comparative industrial peace in the coal mining regions of the United States. Two exceptions to the rule were noted, however, one in the east, Alabama, and one in the west, Colorado. There were occasional cessations from work in the anthracite region of Pennsylvania, but they were not of long duration, and the time lost had no appreciable effect upon the production. The strikes in Alabama affected 7,319 out of a total of 21,438 men, and the average time lost was 32 days per man, a total of 231,112 working days. In Colorado there were 7,103 men out of a total of 9,229 who were idle for an average of 57 days, or a total loss in working time of 407,909 days. In the bituminous region of Pennsylvania there were 12,805 men idle at one time or another during the year, the average time lost being 25 days per man. Considering the great importance of the bituminous coal mining industry of western Pennsylvania, this loss was insignificant, the total idle time lost by strike representing little more than 1 per cent of the total working days, and did not affect the production. Seventy per cent of the entire time lost by strikes in 1903 was borne by these three States. The total number of men idle at any time during the year, not including the unimportant disaffections in the anthracite region of Pennsylvania, were 47,481, and the average time lost for each man was 28 days. The total time idle was equal to 1,341,031 days, or about 1.5 per cent of the total working time. The statistics of labor troubles in the United States during 1902 and 1903 are shown in the following tables:

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	23,698	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

Statistics of labor strikes in the coal mines of the United States in 1903.

State or Territory.	Number of men on strike.	Total days lost.	Average number of days lost per man.
Alabama	7,319	231,112	32
Arkansas	398	2,078	5
Colorado	7,103	407,909	57
Illinois	3,772	70,731	19
Indiana	2,680	46,566	17
Indian Territory	448	1,928	4
Iowa	1,143	11 365	99
Kansas	328	2,516	8
Kentucky	599	13,717	22
Maryland	120	6,045	5
Michigan	75	825	11
Missouri	1,306	13,892	11
New Mexico	54	710	13

Statistics of labor strikes in the coal mines of the United States in 1903—Continued.

State or Territory.	Number of men on strike.	Total days lost.	Average number of days lost per man.
North Dakota	35	340	10
Ohio	4,115	65,149	16
Pennsylvania	12,805	321,925	25
Tennessee	1,639	36,021	22
Texas	1,055	24,460	23
Utah	350	9,800	28
Washington	200	6,600	33
West Virginia	1,524	63,212	41
Wyoming	413	4,130	10
Total	47,481	1,341,031	28

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 1903, 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 total exports of coal from the United States during 1903 amounted to 8,312,098 long tons, valued at $27,190,429, of which 2,008,857 long tons, valued at $9,780,044, were anthracite, and 6,303,241 long tons, valued at $17,410,385, were bituminous coal. The imports of anthracite were equal to about 0.0005 per cent of the total production, and those of bituminous to 0.01 per cent. The imports of anthracite coal into the United States were relatively of no importance; they are principally to San Francisco. A considerable increase has been noted in the imports of bituminous coal in the last three or four years, which has been due to receipts of Nova Scotian coal at Everett, Mass., the fuel being used in the manufacture of retort ovens at the plant of the New England Coal and Coke Company at that place. Compared with the domestic production, however, the total amount of coal imported is of little consequence, having averaged for years less than 1 per cent of the production.

Coal imported and entered for consumption in the United States, 1867–1903.

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	978	$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	492,068	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	1,968,199
1882	36	148	795,722	2,141,378
1883	507	1,172	645,924	3,018,555
1884	1,448	4,404	748,995	2,494,228
1885	4,976	15,848	768,477	2,548,482
December 31—1886	2,089	4,920	811,657	2,501,153
1887	14,181	42,983	819,242	2,609,311
1888	24,098	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	1,363,813	4,561,105

Coal imported and entered for consumption in the United States, 1867-1903—Continued.

Year ending—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
December 31—1892	65,058	$197,583	1,143,304	$3,744,862
1893	53,768	148,112	1,062,993	3,623,892
1894	90,068	234,024	1,242,714	3,785,513
1895	141,837	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	6,984,666
1903	a 175,747	792,657	b 3,293,583	9,319,567

a Includes 93,571 tons of anthracite containing less than 92 per cent fixed carbon, duty free under the special act of 1902, imported in 1902, and 28,041 tons imported in 1903.
b Includes 767,582 tons of slack or culm passing ¾-inch screen imported in 1902, and 577,274 tons imported in 1903.

Coal of domestic production exported from the United States, 1867-1903.

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	1,558,115	....	....
1870	121,098	803,185	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	1,567,666
1875	316,157	1,791,626	203,189	826,943
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	789,532
1882	553,742	2,589,887	314,320	1,102,896
1883	557,813	2,648,033	463,051	1,598,214
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	4,999,239
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

Coal of domestic production exported from the United States, 1867–1903—Continued.

Year ending—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Dec. 31, 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
1903	2,008,857	9,780,044	6,303,241	17,410,385

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 (1903)	long tons	319,068,229	357,356,416
Great Britain (1903)	do	230,334,469	257,974,605
Germany (1903)	metric tons	162,312,075	178,916,600
Austria-Hungary (1902)	do	39,479,560	43,518,319
France (1903)	do	35,002,992	38,583,798
Belgium (1903)	do	23,870,820	26,312,805
Russia (1902)	long tons	15,259,674	17,090,835
Japan (1901)	metric tons	8,945,938	9,861,107
Canada (1903)	short tons	7,996,634	7,996,634
India (1902)	long tons	7,424,480	8,315,418
New South Wales (1902)	do	5,942,011	6,655,052
Spain (1903)	metric tons	2,798,113	3,084,360
South African Republic (1902)	long tons	1,590,330	1,781,170
New Zealand (1902)	do	1,362,702	1,526,226
Mexico (1902)	metric tons	710,000	782,633
Sweden (1902)	do	304,733	335,907
Italy (1902)	do	413,810	456,143
Holland (1902)	do	399,133	439,964
Queensland (1902)	long tons	501,531	561,715
Victoria (1902)	do	225,164	252,184
Natal (1902)	do	592,821	663,960
Cape Colony (1902)	do	165,557	185,424
Tasmania (1902)	do	48,863	54,727
Other countries [a]	do	4,600,361	5,152,404
Total			967,858,406
Percentage of the United States			37

[a] Includes China, Turkey, Servia, Portugal, United States of Colombia, Chile, Borneo and Labuan, Peru, Greece, etc.

As shown in the preceding table, the United States in 1903 produced 37 per cent of the entire world's supply. In 1902 the United States produced 34 per cent of the total, and in 1901, 33.7 per cent. The lead which the United States assumed over Great Britain in 1899 has been increased each year, our production in 1903 exceeding that of Great Britain by nearly 100,000,000 tons, or almost 40 per cent. Great Britain's production last year exceeded her output in 1902 by 3,628,158 short tons, or about 1½ per cent, while the production of the United States increased 55,765,977 short tons, or 18.5 per cent. The aggregate production of Great Britain and all of her colonies in 1903 amounted to 285,967,115 short tons, an amount exceeded by the production of the United States by 71,389,301 short tons, or 25 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 80 per cent more coal than Germany, and in 1903 our production was almost exactly double that of the German Empire.

World's production of coal, by countries, 1868–1903.

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	203,408,008	89,290,834	98,398,500

World's production of coal, by countries, 1868–1903—Continued.

Year.	United States.		Great Britain.		Germany.	
	Long tons.	Short tons.	Long tons.	Short tons.	Long tons.	Short tons.
1891	150,505,954	168,566,668	185,479,126	207,736,621	94,252,278	103,918,136
1892	160,115,242	179,329,071	181,786,871	203,601,296	92,544,050	102,029,815
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	252,208,056	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
1903	319,068,229	357,356,416	230,334,469	257,974,605	162,312,075	178,916,600

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	27,504,082	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	29,067,978	32,014,871	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	35,856,000	39,515,516	30,797,629	33,938,967	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	39,479,560	43,518,319	30,196,994	33,286,146	22,877,470	25,217,835
1903	....	....	35,002,992	38,583,798	23,870,820	26,312,805

World's production of coal, by countries, 1868–1903—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	16.96
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	8,945,938	9,861,107	30,565,923	870,711,044	33.69
1902....	15,259,674	17,090,835	....	(a)	[b] 37,907,163	888,644,787	33.94
1903....	....	....	....	....	....	....	....

[a] Latest available figures are used in making up totals for 1902.
[b] This includes, in addition to the countries named in the following pages, the output of Holland, 439,964 tons; Natal, 663,960 tons; Cape Colony, 185,424 tons; Tasmania, 54,727 tons; Mexico, 782,633 tons; China, Turkey, Servia, Portugal, etc. (estimated), 5,152,404 tons; total, 7,278,730 tons (1902).

Production of minor coal-producing countries, 1868–1903.

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	1,563,381	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	2,362,896	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	596,475
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	568,290	975,234	1,092,262
1900	5,507,497	6,168,397	497,132	556,788	1,093,990	1,225,269
1901	5,958,426	6,684,637	539,472	604,209	1,227,638	1,374,955
1902	5,942,011	6,655,052	501,531	561,715	1,362,702	1,526,226
1903	....	....	....	....	....	....

Production of minor coal-producing countries, 1868-1903—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	....	....	933,808	....	....	....	....
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	1,038,805	1,144,781
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	1,158,755	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	2,069,906
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	3,027,982
1902	225,164	252,184	7,639,225	7,433,972	8,326,049	2,807,550	3,094,762
1903	....	....	7,996,634	....	....	2,798,113	3,084,360

Production of minor coal-producing countries, 1868–1903—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	98,555	108,144	....	....	....	....
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	158,654	....	....	....	....
1881	134,582	148,377	....	....	....	....
1882	164,737	181,623	....	....	....	....
1883	214,121	235,961	....	....	....	....
1884	223,322	246,218	....	....	....	....
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	198,088	218,331	....	....
1892	295,718	326,024	199,380	219,816	....	....
1893	317,249	349,767	199,933	220,426	548,534	614,358
1894	271,395	299,108	218,633	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	1,640,085
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	413,810	456,143	304,733	335,907	1,590,330	1,781,170
1903	....	....	....	....	....	....

COAL TRADE REVIEW.

The most marked feature in connection with the coal-mining industry in 1903 was the comparative peace which reigned throughout the coal-mining regions, a period of calm after the stormy scenes of 1902. There were only two States in which the production was seriously disturbed by general strikes, these being Alabama and Colorado. In neither of these States, however, was the disturbance of sufficient length or general character to cause a decrease in the production of coal. The year 1903, in addition to the general peace, was one of unprecedented activity throughout most of the coal-producing States. The car supply, while not up to all that was desired in some of the coal-mining regions, was in much better condition than that which prevailed in 1902, and the railroads were better equipped for the transportation of coal from the mines to the consuming and distributing centers. Prices at the mines ruled higher than at any time within the last fifteen years, and while in some instances an oversupply was created in some of the principal cities, with the natural result of reduced prices, the general situation was one of satisfaction to producing, transporting, and selling interests. Consumers were naturally disposed to complain of the high prices which they were obliged to pay for fuel, but as there was no decided setback to the prevailing satisfactory trade conditions, the consumers were able to meet this increased expense.

A comprehensive idea of the conditions which prevailed throughout the United States may be obtained from the following reviews of the coal trade in the principal cities. These reviews have been prepared by secretaries of boards of trade or other local authorities familiar with the coal-trade conditions.

NEW YORK, N. Y.

The following review of the coal trade of New York City has been prepared for this report by Mr. Samuel Sanford, associate editor of the Engineering and Mining Journal:

The year 1903 was the most satisfactory in the history of the New York coal trade for the large anthracite sales agencies, but was unsatisfactory for sellers of some grades of bituminous. A large amount of coal consigned to New York firms is transshipped by them to points on Long Island Sound, and detailed statements of such transshipments have not been compiled, but the tonnage of anthracite sold was undoubtedly the largest on record, while prices averaged higher than in any year since 1875.

Concerning the financial control of the great mining and transportation companies, the most noteworthy event reported was the transfer of a large block of Philadelphia and Reading Railroad stock to the Baltimore and Ohio and the Lake Shore railroads; the transfer increased the Pennsylvania and Vanderbilt interest in the anthracite industry and lessened that of J. P. Morgan & Co. Another event was the retirement of Mr. Olyphant from the presidency of the Delaware and Hudson Company, followed by a general reorganization of several departments of the road. Still another happening of some interest was the suit brought before the Interstate Commerce Commission by a certain newspaper owner against the anthracite railroads, alleging discriminations in freight rates, excessive rates, and a combination to maintain prices of coal. The hearings before the Interstate Commerce Commission brought out very little that was not already a matter of record, and were cut short by a decision of Judge Lacombe denying the Commission's power to take certain evidence. The Commission appealed to the United States Supreme Court.

Anthracite was in short supply at the opening of 1903, prepared sizes selling at retail for $13 per ton in New York. Wholesale prices varied widely. The largest companies had refused to take advantage of public need, and after the miners resumed work in 1902 sold coal at a stated price of $5 per ton for egg, stove, and chestnut sizes. Some so-called independent operators, however, who sold to larger concerns under contracts calling for 65 per cent of the average tidewater price, objected to receiving 65 per cent of $5, claiming that the actual price was around $10. To avoid damage suits the large companies voluntarily abrogated these contracts for three months, buying the coal at the breaker and selling it back to the operator at tidewater, leaving him free to get any price he could. Before February, owing to extraordinary activity at the mines and heavy shipments, prices broke, coal selling at retail in New York for $7.50, while the speculative prices free on board for stove size was $5.50. By March retail prices at New York had fallen to $6.25 for egg, stove, and chestnut sizes, and wholesale prices went down to the $5 mark previously named by the large concerns, and the independent operators found some difficulty in collecting money due for $10 coal from speculators, who were selling at a loss. Early in April the Philadelphia and Reading Coal and Iron Company announced basis prices of $4.75 for broken and $5 for egg, stove, and chestnut sizes, with graded discounts for certain months. Other companies made similar announcements, and a great rush of orders resulted, householders who had never sought to take advantage of spring discounts before remembering their experiences since the previous June, and buying liberally. This retail demand remained unusually brisk until well into July, with resulting activity in the wholesale trade, as New York dealers, having limited storage capacity, normally buy but little during the late spring and the whole summer. By August the effects of the previous year's strike had about passed, and conditions were nearly normal. The small steam sizes, owing to the great decline in the prices of bituminous and to the short-sighted policy of many anthracite producers, who during the winter had sold as coal stuff that was little better than culm, the market for steam sizes was dull. It continued to decline until November. The demand for prepared sizes did not decline so soon, but buying during September and October was light. The coming of cold weather late in November put the trade on a winter basis.

New York Harbor prices, free on board, asked by the principal companies for free-burning white ash coal was as follows: January, February, and March, broken, $4.75; egg, stove, and chestnut, $5; April, broken, $4.25; egg, stove, and chestnut, $4.50; May, $4.35 and

$4.60; June, $4.45 and $4.70; July, $4.55 and $4.80; August, $4.65 and $4.90; September, October, November, and December, $4.75 and $5. The prices obtained on sales, as reported to the commissioner appointed by the Anthracite Strike Commission, for the months of May to December, inclusive, were a little below the prices asked, the difference being due to concessions made on large and long-time contracts or on special lots.

The two most important consolidations affecting the New York bituminous trade in 1903 were the bringing under one control of the Consolidation Coal Company of Maryland, the Fairmont Coal Company of West Virginia, and the Somerset Coal Company of Pennsylvania, through Baltimore and Ohio Railroad interests, and the formation of the Pennsylvania Coal and Coke Company, which ships from mines in the Clearfield region of Pennsylvania over the Pennsylvania and the New York Central railroads. The year opened with demand heavy, and bituminous prices equaling those of the prepared sizes of anthracite, but soon declined, and by January 10 ordinary grades of Clearfield were selling for $7, free on board, New York shipping ports. By February 1 prices were down to $5.25 and by February 20 to $3.25. The break was chiefly due to large offerings of British coal at $4.50 to $5, alongside, North Atlantic ports. Contract prices for the new year beginning April 1 were, however, fixed at $3.35 for average grades of Clearfield, free on board, New York Harbor ports, with special grades in proportion. This large advance over the previous year's prices was made by influential producers against the advice of the most experienced men in the trade. Consumers did not come forward at these prices, and concessions were made by producers of the poorer grades. Car supply at the mines, which had been about 25 per cent of producers demands early in February, increased to 50 per cent by May 1, while transportation was prompt. A further increase in car supply and no improvement in demand caused the market to sag, and by May 15 ordinary grades of Clearfield sold at $2.50, free on board, New York Harbor shipping ports, while some lots on which demurrage was accumulating sold as low as $2.40. During the last half of the year strikes in many industries, and abundant waterpower for those concerns using it, reduced consumption, while the market had suffered from heavy arrivals of foreign coal. From July 15 until into October ordinary grades of Clearfield sold at $2.50 to $2.85, free on board, New York Harbor shipping ports.

In October producers of certain special grades, who found it impossible to maintain contract prices in the face of price cutting that had continued for months, virtually abrogated their contracts, prices of poorer grades suffered in sympathy, and the market was temporarily demoralized, ordinary grades of Clearfield selling at $2.40 to

$2.50, free on board, New York Harbor shipping ports into December. The year closed with these prices prevailing: Georges Creek, $3 to $3.50; best Clearfield, $2.60 to $2.80; fair Clearfield, $2.50 to $2.60; best gas coal, $3.05 to $3.15.

During the last half of the year the railroads, owing to lessened industrial activity, gave prompt transportation to tidewater and furnished cars enough for the urgent needs of operators. Coastwise freight rates showed wide fluctuations during the year, owing to the variation in the demand for coal. Early in January some vessels got the remarkable rate of $2.50 from New York to Boston and $1.50 to Long Island Sound ports. By January 10 rates from New York were $1.50 to Boston and $1 to Providence, New Bedford, and Long Island Sound, and by March 5 were 65 to 75 cents to Long Island Sound, and $1.05 to $1.15 to Boston, Salem, and Portland. Barge rates to near-by Sound ports fell from 35 to 40 cents in January to 20 cents in March. Rates during the spring and summer fell slightly. In September the following rates prevailed: Providence, New Bedford, and Long Island Sound, 65 to 75 cents; Boston, Salem, and Portland, 75 to 80 cents. In November the rates were: Providence, New Bedford, and Long Island Sound, 60 cents; Boston, Salem, and Portland, 70 cents. In December they were: Providence, New Bedford, and Long Island Sound, 50 cents; Boston, Salem, and Portland, 60 to 65 cents.

BOSTON, MASS.

The coal trade of Boston is reviewed by Mr. Elwyn G. Preston, secretary of the Chamber of Commerce, as follows:

The coal trade of Boston during spring of 1903 witnessed a return to normal conditions from the extraordinary conditions that prevailed during 1902, followed by a reaction during the summer and fall months, which appeared to be in the nature of a legacy of exhaustion from the excitement of the previous year. The settlement of the strike in the fall of 1902 was followed by increased receipts of both anthracite and bituminous coal, but not in sufficient amount to take care of the late winter requirements. As a result, prices remained for some months at the high level reached at the close of 1902.

The table following shows the receipts of both anthracite and bituminous coal for the past year as compared with previous years.

Receipts of coal at Boston, Mass., for twenty years.

[Long tons.]

Year.	Domestic.				Foreign.		Total.
	By water.		All rail.				
	Anthracite.	Bituminous.	Anthracite.	Bituminous.	Anthracite.	Bituminous.	
1884	....	....	....	....	....	....	2,225,740
1885	....	....	....	....	....	....	2,221,220
1886	....	....	....	....	....	44,464	2,500,000
1887	....	....	....	....	....	13,966	2,400,000
1888	2,057,279	1,004,195	....	....	....	10,081	3,071,555
1889	1,647,348	914,966	....	....	....	5,538	2,567,852
1890	1,740,564	964,857	....	....	....	14,072	2,719,493
1891	2,039,443	1,070,088	....	....	....	5,842	3,115,373
1892	2,163,984	919,815	....	....	....	1,416	3,085,215
1893	2,227,086	1,100,384	....	a50,000	....	17,097	3,394,567
1894	2,237,599	958,701	....	a71,303	....	41,779	3,309,382
1895	2,518,441	977,762	....	a90,999	....	21,009	3,608,211
1896	2,092,798	1,391,949	....	a104,080	....	61,071	3,649,898
1897	1,948,283	1,591,245	32,836	65,674	....	50,235	3,688,273
1898	1,835,806	1,706,929	31,071	62,143	....	17,122	3,653,071
1899	2,178,791	1,746,780	47,303	94,614	....	201,671	4,269,159
1900	1,973,733	2,086,260	32,146	64,291	....	551,817	4,708,247
1901	2,139,989	2,063,691	23,569	47,139	....	538,031	4,812,419
1902	974,649	2,103,696	40,755	120,812	41,766	1,001,520	4,283,198
1903	2,042,512	2,078,499	109,033	185,330	22,432	1,226,134	5,663,940

a Total anthracite and bituminous.

The receipts of domestic bituminous coal were slightly in excess of the previous year, the falling off by water being more than counterbalanced by the all-rail receipts. The receipts of foreign bituminous coal exceeded those of the previous year by 225,000 long tons, aggregating 1,226,134 long tons, and constituting 54 per cent of the total bituminous receipts. Of the foreign bituminous coal 644,462 long tons came from Nova Scotia and Cape Breton, the balance coming from various ports of Great Britain. The British coal was received principally during the first four months of the year.

The receipts of domestic anthracite coal were 2,151,545 long tons, as compared with 1,015,404 tons in 1902 and 2,163,558 tons in 1901. Only 22,432 tons of foreign anthracite were received during 1903, practically all coming from Hull and Swansea.

The table following shows the amount of coal received at Boston and forwarded to interior New England points and the net receipts at Boston, which represents coal entering into local consumption.

Monthly receipts of coal at Boston, Mass., for 1903, with comparisons.

[Long tons.]

Month.	Receipts, all routes.		Amount forwarded to New England points.		Net receipts (for local consumption).	
	Anthracite.	Bituminous.	Anthracite.	Bituminous.	Anthracite.	Bituminous.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
January	230,218	364,110	16,915	97,412	213,303	266,698
February	182,911	462,004	27,963	87,469	154,948	374,535
March	120,093	342,326	18,515	102,707	101,578	239,619
April	160,024	316,829	26,414	84,599	133,610	232,230
May	211,937	289,283	19,042	74,087	192,895	215,196
June	163,673	213,564	17,375	92,665	146,298	120,899
July	240,011	298,383	31,851	78,874	208,160	219,509
August	198,952	242,929	42,347	58,144	156,605	184,785
September	226,699	268,090	35,492	44,852	191,207	223,238
October	176,719	216,467	17,686	60,383	159,033	156,084
November	135,577	233,336	7,852	69,157	127,725	164,179
December	127,163	242,642	15,641	65,348	111,522	177,294
Total, 1903	2,173,977	3,489,963	277,093	915,697	1,896,884	2,574,266
Total, 1902	1,057,170	3,226,028	108,209	762,593	948,961	2,463,435
Total, 1901	2,163,558	2,648,861	333,178	792,225	1,830,380	1,856,636
Total, 1900	2,005,879	2,702,368	397,417	851,332	1,608,462	1,851,036
Total, 1899	2,226,094	2,043,065	461,827	647,533	1,764,267	1,395,532
Total, 1898	1,866,877	1,786,194	368,960	663,008	1,497,917	1,123,186
Total, 1897	1,981,119	1,707,154	418,171	734,541	1,562,948	972,613

From this table it will be observed that the receipts of anthracite coal which entered into local consumption were almost exactly double the quantity of the previous year. It is impossible to determine with any accuracy the stocks on hand at the beginning of the year but it is quite safe to assume that these figures do not represent the relative consumption, but that the consumption of 1902 was considerably more than one-half that of 1903—probably about three-fourths.

Coal freights covered a wide range, the year opening at high figures, owing to the great demand for tonnage to move the coal then offering. Contrary to the usual conditions, the low prices were reached during the fall and winter months instead of during the ordinary midsummer dullness. The following statement shows the range and the months during which the extreme prices were obtained:

Coal freights to Boston during 1903.

From—	Minimum.		Maximum.	
	Rate.	Date.	Rate.	Date.
New York	$0.55 to $0.65	December	$2.00	January.
Philadelphia	.75 to .80	....do	2.00 to 2.25	Do.
Baltimore	.85	....do	2.50	Do.
Norfolk and Newport News	.80	....do	2.00	Do.

The extraordinary prices quoted in December of 1902 and January, 1903, caused additions to be made to the coal-carrying fleet of vessels ordinarily employed in other trades, which in part accounted for the long continuance of low-vessel freights.

The prices for anthracite coal in the local market covered a wide range, the year opening with stove coal quoted at retail in the Boston market at $12, and pea grades at $10, these prices being maintained by the large dealers for transactions with their old customers. Isolated transactions were had at much higher prices, one cargo of anthracite being reported as bringing $12.75 per ton alongside the wharf at Boston.

The price fell early in February to $10 for stove coal, and by gradual reductions during the month to $7.50 in March. The low price of the year was quoted in April, viz, $6.50 per ton. In May the price was advanced to $6.75 and in September to $7, at which figure it remained during the balance of the year. There was little, if any, cutting of prices, practically all the dealers having agreed upon uniform rates and maintaining them.

Prices of bituminous coal showed less firmness and stability. At the opening of the year Georges Creek Cumberland coal was quoted at $10 in retail lots to regular customers, although not a few sales in cargo lots, alongside, were made at this figure.

English coals sold at the same time from $8 to $8.35 per ton, and later for $5.75 to $7.50, the low figure being a sacrifice price to avoid heavy demurrage charges, and also representing to some extent the wide variations in quality which characterized the receipts of English coal in this market.

In the latter half of January the price of Georges Creek was reduced to $9 and later to $8, alongside, and early in February to $6. Later in the month, owing to heavy receipts and a very slow demand, the market broke to a range of $4 to $5 for Georges Creek, Clearfield selling at the same time for about $3.60. From April 1 the price of Georges Creek was maintained firmly at about $4.25 to $4.75, depending entirely upon vessel freights, the price at tide water at shipping point being $3.35. Cheaper coals sold at a substantial discount, the price reaching $3 at times for individual lots in order to secure quick discharge.

Not in recent years has there been such long continued dullness in the soft coal market as was experienced during the summer and fall months. The light consumption by cotton and woolen mills, owing to restricted production, was responsible in part for this condition; but there appeared to be a widely prevalent feeling that lower prices were inevitable and consumers delayed putting in stocks. As a result, in order to move the coal, some concessions were made in prices, Georges Creek in September being quoted at about $4.15 and New River as low as $3.50 to $3.60. Later these prices were still further shaded, New River selling as low as $3.25 in October and November, and Georges Creek from $3.50 to $3.60. Clearfield coal was freely offered at $3 and some sales were effected as low as $2.75, these figures constituting the low prices for the year.

At the close of the year the stocks in consumers' hands were smaller than for some years, which would indicate the likelihood of a better demand during the coming year.

PHILADELPHIA, PA.

Mr. Samuel R. Kirkpatrick, railroad editor of the Press, has prepared the following review of the coal trade of Philadelphia in 1903:

In the early part of 1903 there was a decided rush for all sizes of coal. There was comparatively no anthracite in the bins of the dealers or the consumers. The strike of the previous year and the severe winter had depleted the supply, and for months it was a hand-to-hand affair not only with the consumer, but with the dealer as well. For the first three months of the year there was little coal to be had. The mines were being worked to their fullest capacity and a greater production than ever was being made, but the production was not enough to meet the requirements. Actual consumption had fallen off, but the housekeepers, having in mind the experiences of 1902, decided to stock up early. All the dealers were in the market for a large supply, but the coal companies adopted the policy of parceling it out so that all sections could secure a share of what was to be had. It has been the practice for years for the consumer to stock up with coal for the winter after the vacations were over. In 1903 vacations were of minor importance and the winter's supply was laid in before the house was closed for the summer. There was also some fear that there would be further trouble with the miners, and, notwithstanding the agreements made, it was believed by some that every means would be advanced to get out of them.

The amount of anthracite coal sold in this city prior to June 30 was greater than ever before, and there was never in the previous history of the hard-coal trade a time when the dealers had filled so many orders and had so little coal on hand. From July on the business began to drop off. Not only were domestic sizes accumulated, but the amount of steam sizes on hand was greater than the companies cared to carry. Later in the year a reduction was made on rice and buckwheat. The labor troubles, which compelled a large number of manufacturing establishments to close, caused a falling off in the consumption of steam sizes. Owing to the increased cost of mining the price of anthracite at the mines was about 50 cents higher than in the previous year. It is likely that there will be no reduction in the price of coal from the mines for some time, except that the regular spring reduction of 50 cents in April is likely to be an established practice. The retail trade expects this rule to be continued, and it has made preparations to transact business on this basis.

The Philadelphia and Reading Coal and Iron Company exceeded all others in the amount of anthracite coal brought to this city. There was a decided increase in the amount of anthracite sold in 1903 as compared with 1902. It was even larger than in 1901. At the close of the year there was very little stock of domestic sizes on hand either by the dealers or the large coal-producing companies. Owing to the strike in 1902 the amount of anthracite consumed in this city in that year was 2,602,022 long tons as compared with 4,024,606 tons in 1901. In 1903 the amount was 4,194,027 long tons. It is believed that it was larger than this, but exact figures are not obtainable, owing to the destruction by fire of the Baltimore and Ohio Railroad Company's records. The amount carried by that road has been estimated by the officials of the company. There was a slight falling off in the bituminous tonnage. This was in part due to the shutting down of a number of factories and partly to the return by other manufacturing establishments to the use of anthracite as fuel.

During the year 1903 the coal companies produced the largest tonnage in the history of anthracite mining. Heretofore it has seemed almost impossible to mine 5,000,000 tons for more than two months in succession. Such was not the case in 1903. For several months a production of over 5,000,000 tons was made, but even with this large tonnage there was very little coal of prepared sizes on hand at the close of the year. There was some uncertainty displayed by the dealers, many believing that there would be a reduction in prices. But the prices which were put in effect in October, 1902, were continued, except that the regular spring reduction was made. For the best part of the year the retail prices were unchanged, and notwithstanding the reduction of 50 cents a ton made by the operators in April, many dealers had so many orders on their books at the old prices that they continued to secure those figures, and it was not until the latter part of the year that they endeavored to secure a larger trade. In the last three months of 1903 there was very little coal sold, and some of the large coal companies not only restricted the output but began to stock coal, and a general reduction was made in the price of rice and buckwheat with a view of reducing the stocks of these sizes. This action created a little better market, but the improvement was of short duration. Many of the large manufacturing establishments that were forced to use bituminous coal during the strike of the anthracite miners were not inclined to return to the use of anthracite, claiming that soft coal gave a better heat and was not nearly as expensive.

Outside of the spring and winter circulars there were no official changes made in the price of anthracite coal at the mines. Some of the companies which had more or less inferior coal were reported as making slight concessions, but as a whole the trade was firm and harmony prevailed between the various coal companies.

The Philadelphia and Reading Coal and Iron Company is becoming each year more of a factor in the bituminous trade. Its soft-coal tonnage was considerably larger in 1903, and the prospects are that it will further increase.

During the year 1903 there was a slight decrease in the amount of bituminous coal used in this city. The falling off was mainly due to the decrease in business and the closing down of a number of factories and mills. The large amount of soft coal used in the previous year was due to the strike of the anthracite coal miners and the inability of the consumers to secure that fuel. Many plants changed their grates so that soft coal could be used.

The consumption of bituminous coal in this city in 1903 was 2,088,655 long tons, as compared with 2,266,822 tons in 1902. About April 1 there was a general advance in the price of this fuel, but the dull trade soon caused the dealers to shade prices, and for the best part of the year the bituminous trade was irregular and unsatisfactory. In addition to this, bituminous operators along the line of the Pennsylvania Railroad were again confronted with a car famine. At times when there was a demand for bituminous coal it was almost impossible to secure cars to handle it. The general business along this road was heavier than ever, and at every terminal point long lines of freight trains were congested. Toward the end of the year the car situation became better, but by that time the demand for bituminous had fallen off.

The shipments to points outside of Philadelphia were 2,350,000 long tons, as compared with 3,803,971 tons in 1902 and 4,081,326 tons in 1901. The amount of bituminous sent abroad was 529,235 tons, a decrease of 17,168 tons.

The shipments of anthracite coal abroad were almost double what they were in 1902, they being 25,287 tons as against 13,140. Owing to the anthracite coal strike in the previous year the storage yards were depleted of coal, and no attempt was made to establish a European market. As is always the case, most of the anthracite exported was consigned to Cuba, that country taking 10,858 tons, valued at $55,352. Newfoundland took 7,142 tons, valued at $43,295. Only five countries took anthracite from this city—British West India, Cuba, Nova Scotia, Newfoundland, and Japan. The latter country took 127 tons, valued at $635. Cuba also imported the largest amount of bituminous coal, 286,391 tons being consigned to that place.

The total amount of anthracite coal distributed in this city in 1903 was 6,047,283 tons, and of bituminous 6,810,331 tons.

There was no falling off in the consumption of pea and buckwheat sizes. Each year more of these sizes are demanded not only by manufacturing establishments but by the housekeeper. In some dwellings pea coal is used almost exclusively in the kitchen stoves, and in many cases it is also used in the furnaces. The strike taught many consumers of hard coal how to economize, and there is more system used in the burning of this fuel than ever before. Besides, the coal companies are now using their culm banks, and even smaller sizes than buckwheat are disposed of. The large production during the year caused a big amount of steam sizes to pile up, and for a time all sizes below chestnut were somewhat of a glut in the market.

The following are the prices of the smaller sizes of coal for each month of 1903:

Prices for steam sizes of anthracite at the mines during 1903, by months.

[Per long ton.]

Month.	Pea.	Buckwheat.	Rice.
January	$1.75-$2.25	$1.50-$1.75	$0.50-$0.75
February	1.75- 2.25	1.50- 1.75	.50- .75
March	1.50- 2.25	1.25- 1.75	.50- .75
April	1.50- 1.75	1.25- 1.50	.40- .65
May	1.50- 1.75	1.25- 1.50	.40- .65
June	1.25- 1.75	1.10- 1.50	.30- .65
July	1.25- 1.75	1.00- 1.50	.25- .65
August	1.25- 1.75	.90- 1.25	.25- .65
September	1.50- 1.75	.90- 1.25	.25- .65
October	1.50- 1.75	1.10- 1.25	.25- .65
November	1.60- 1.75	1.00- 1.25	.35- .65
December	1.60- 1.75	1.00- 1.25	.45- .75

The price circular of the Philadelphia and Reading Coal and Iron Company, which is the same as the other companies, is as follows:

Circular prices for anthracite coal in Philadelphia, Pa., during 1901, 1902, and 1903.

Size.	1901.			1902.			1903.	
	April.	September.	October.	March.	May.	October.	April.	September.
Lump and steamboat	$2.00	$2.50	$2.50	$2.50	$2.50	$3.00	$3.25	$3.75
Broken	2.25	2.75	2.75	2.50	2.60	3.50	3.00	3.50
Egg	2.50	3.00	3.00	2.75	2.85	3.75	3.25	3.75
Stove	2.75	3.25	3.25	2.75	2.85	3.75	3.25	3.75
Chestnut	2.75	3.25	3.25	2.75	2.85	3.75	3.25	3.75
Pea	1.50	1.75	1.75	1.75	1.75	2.25	2.00	2.00
Buckwheat	1.25	1.25	1.25	1.25	1.25	1.75	1.75	1.75

There was only one circular that was used as a basis. On April 1 the regular circular was issued, but a footnote was attached which stated the price would be 50 cents a ton below the circular that month, but there would be an advance of 10 cents a month until the regular price was reached.

The following table shows the actual selling prices of prepared sizes for years 1900, 1901, 1902, and 1903:

Selling prices of prepared anthracite coal at the mines for Philadelphia, Pa., for four years, 1900–1903.

[Per long ton.]

Month.	Sizes.	1900.	1901.	1902.	1903.
January	Broken	$2.35–$2.50	$2.25–$2.75	$2.75	$3.50
	Egg	2.85	3.00	3.00	3.75
	Stove	2.95	3.25	3.25	3.75
	Nut	2.95	3.25	3.25	3.75
	Pea	1.60–1.75	1.60–1.75	1.75	1.75–$2.25
February	Broken	2.35–2.50	2.25–2.75	2.75	3.50
	Egg	2.85	3.00	3.00	3.50–3.75
	Stove	2.95	3.25	3.25	3.50–3.75
	Nut	2.95	3.25	3.25	3.50–3.75
	Pea	1.35–1.75	1.60–1.75	1.75	1.75–2.25
March	Broken	2.25–2.50	2.25–2.75	2.40–$2.75	3.25–3.50
	Egg	2.85	3.00	3.00–3.50	3.25–3.75
	Stove	2.95	3.25	2.75–3.25	3.25–3.75
	Nut	2.95	3.25	2.75–3.25	3.25–3.75
	Pea	1.35–1.75	1.60–1.75	1.40–1.75	1.50–2.25
April	Broken	2.10–2.35	2.25	2.25–2.50	3.00
	Egg	2.40	2.50	2.75	3.25
	Stove	2.65	2.75	2.75	3.25
	Nut	2.65	2.75	2.75	3.25
	Pea	1.35–1.50	1.60	1.30–1.60	1.50–1.75
May	Broken	2.10–2.35	2.25–2.35	2.35–2.60	3.10
	Egg	2.40	2.60	2.85	3.35
	Stove	2.65	2.85	2.85	3.35
	Nut	2.65	2.85	2.85	3.35
	Pea	1.35–1.50	1.60	1.30–1.60	1.50–1.75
June	Broken	2.10–2.25	2.25–2.45	5.00–7.50	3.20
	Egg	2.00–2.40	2.70	4.50–6.00	3.45
	Stove	2.25–2.50	2.95	4.50–6.00	3.45
	Nut	2.25–2.50	2.95	4.50–6.00	3.45
	Pea	1.35–1.50	1.60	3.25–4.00	1.25–1.75
July	Broken	2.00–2.25	2.25–2.55	5.00–10.00	3.30
	Egg	2.25–2.75	2.80	5.00–6.00	3.55
	Stove	2.25–2.75	3.05	5.00–6.50	3.55
	Nut	2.25–2.75	3.05	5.00–6.50	3.55
	Pea	1.10–1.50	1.60	4.00–5.00	1.25–1.75
August	Broken	2.00–2.35	2.25–2.65	8.00–12.00	3.40
	Egg	2.00–2.50	2.90	6.50–9.00	3.65
	Stove	2.25–2.75	3.15	6.50–9.00	3.65
	Nut	2.25–2.75	3.15	6.50–9.00	3.65
	Pea	1.00–1.50	1.60	4.25–6.00	1.25–1.75

Selling prices of prepared anthracite coal at the mines for Philadelphia, Pa., for four years, 1900–1904—Continued.

Month.	Sizes.	1900.	1901.	1902.	1903.
September	Broken	2.10- 2.35	2.25- 2.75	8.00- 12.00	3.50
	Egg	2.25- 2.50	2.75- 3.05	7.50- 12.00	3.75
	Stove	2.50- 2.75	3.25	7.50- 12.00	3.75
	Nut	2.50- 2.75	3.25	7.50- 12.00	3.75
	Pea	1.00- 1.50	1.40- 1.60	5.00- 6.50	1.50- 1.75
October	Broken	2.50- 3.00	2.25- 2.75	8.00- 12.00	3.50
	Egg	3.25- 3.75	2.75- 3.05	7.50- 12.00	3.75
	Stove	3.25- 4.25	3.25	7.50- 15.00	3.75
	Nut	3.25- 4.25	3.25	7.50- 15.00	3.75
	Pea	2.25- 3.25	1.40- 1.60	5.00- 7.50	1.50- 1.75
November	Broken	2.75	2.25- 2.75	3.50- 5.00	3.50
	Egg	3.00	2.75- 3.05	3.75- 6.00	3.75
	Stove	3.25	3.25	3.75- 6.00	3.75
	Nut	3.25	3.25	3.75- 6.00	3.75
	Pea	1.75- 2.00	1.40- 1.60	2.25- 3.50	1.60- 1.75
December	Broken	2.75	2.25- 2.75	3.50- 7.50	3.50
	Egg	3.00	2.75- 3.05	3.75- 7.50	3.75
	Stove	3.25	3.25	3.75- 7.50	3.75
	Nut	3.25	3.25	3.75- 7.50	3.75
	Pea	1.75- 2.00	1.40- 1.60	2.25- 5.00	1.60- 1.75

There was no change in freight rates for local delivery during the year. The charges per ton, which vary according to the region from which the shipment is made and according to size of coal, were as follows:

Freight rates on anthracite coal from regions to Philadelphia, Pa.

[Per long ton.]

Region.	Prepared sizes.	Pea.	Buckwheat.
Schuylkill	$1.70	$1.40	$1.25
Lehigh	1.75	1.45	1.30
Wyoming	1.80	1.50	1.35

Through the courtesy of the officers of the Pennsylvania Railroad Company, the Philadelphia and Reading Railway Company, the Lehigh Coal and Navigation Company, and the Baltimore and Ohio Railroad Company data have been furnished from which the following table has been compiled. It shows the distribution of coal at Philadelphia for the export trade, the coastwise and harbor trade, and the Philadelphia local trade.

Distribution of coal at Philadelphia, Pa., in 1902 and 1903.

[Long tons.]

Destination.	1902.		1903.	
	Anthracite.	Bituminous.	Anthracite.	Bituminous.
Export	13,140	546,403	25,287	529,235
Coastwise and harbor	683,312	3,803,971	1,827,969	4,192,441
Local	2,602,022	2,266,822	4,194,027	2,088,655
Total	3,298,474	6,617,196	6,047,283	6,810,331

There was imported at this port 39,778 tons from England and 4,049 tons of bituminous coal from Scotland, valued at $118,349.

BALTIMORE, MD.

The following review of the coal trade of Baltimore has been prepared by Mr. Maurice J. Lunn, editor of Coal and Coke:

The abnormally high prices for coal and coke which marked the latter part of the year 1902 extended over into 1903, and during the early part of the year the coal trade was very active, with high prices and with demand exceeding the supply, but this condition was not of long duration. The efforts on the part of the railroads to relieve the freight congestion, which brought about much better service in the movement of coal and coke, together with warmer weather about the middle of February and the arrival of foreign coal, caused a softening of the high prices previously prevailing. However, an active trade, with prices firm, continued well into May, the price of bituminous coal averaging about $2 per ton at the mines, with an occasional sale only at $1.75 per ton, but by the early part of June trade was somewhat dull and prices, while no lower, were not at all firm.

The condition of the market in the latter part of August and early September was weak, with a decided slump in prices. With September the fall trade set in, and there was quite an improvement in the demand for both coal and coke, with prices steady, but this was soon checked with the curtailment of the production of iron and steel for the last quarter of the year. This action on the part of the iron and steel industries seriously affected the coal and coke trade, and the coal operators, both anthracite and bituminous, as well as the coke manufacturers, were at this time endeavoring to devise plans whereby the output would be largely restricted, with the view of maintaining prices for the last three months of the year. Little success followed their efforts in this direction, and the last quarter of the year was unsatisfactory for the coal man, the trade being very inactive, with low prices ruling, while during the same period of 1902 the highest prices of that phenomenal year prevailed, with anthracite coal for domestic use at $20 per ton delivered, crushed coke at $15, and bituminous coal at $8.

Below will be found a statement of the receipts of coal at Baltimore, Md., for the year ended December 31, 1903. It is regretted that owing to a large number of records having been destroyed in the Baltimore fire of February, 1904, it is not possible to classify the 1903 tonnage, giving the shipments at tide water, coastwise and export, and the quantity consumed in Baltimore.

Receipts of coal at Baltimore, Md., 1903, compared with the year 1902.

[Long tons.]

Kind.	1903.	1902.	Increase.
Bituminous coal	3,104,163	2,786,484	317,679
Anthracite coal	728,628	610,175	118,453
Total	3,832,791	3,396,659	436,132

To secure the real tonnage of Baltimore for the year 1903, there should be added to the above figures the consumption of coal at the Maryland Steel Company's plant at Sparrows Point, Md., a suburb of Baltimore, situated on the Patapsco River, about 9 miles from the city. These figures for 1903 are furnished through the courtesy of Mr. F. W. Wood, president of the company. The consumption of bituminous coal at the plant was 404,043 tons of 2,240 pounds. Notwithstanding the fact that this plant began the manufacture of its own coke about the middle of the year, it used coke from outside sources to the extent of 217,170 short tons.

Another industrial concern in the outlying district of Baltimore is the Central Foundry Company, whose plant is also located on the Patapsco River, at Dundalk, Md., about 6 miles from the city. The statement of its consumption for the year 1903 is due to the courtesy of the superintendent, Mr. Voorhees; it amounts to 2,030 tons of bitumnious coal and 3,267 tons of coke. Adding these to the receipts given in the foregoing table, the total receipts at Baltimore in 1903 amounted to 4,238,864 long tons of coal and 220,437 short tons of coke.

NORFOLK, VA.

Col. William Lamb reports the total receipts of coal at Norfolk in 1903 at 2,248,555 long tons, as compared with 2,285,854 long tons in 1902, showing a decrease in receipts at this port of 37,299 long tons in 1903. Of the total receipts in 1903, 1,599,145 long tons were from the Pocahontas region, while 649,411 tons were made up of shipments from the Clinch Valley district in Virginia, and the Thacker field in West Virginia. The receipts of Pocahontas coal exhibit a decrease in 1903, as compared with the preceding year, of nearly 700,000 long tons, as shown in the following table:

Pocahontas coal receipts at Lambert Point piers since 1891.

[Long tons.]

Year.	Foreign.	Bunkers.	Coastwise.	Local.	Total.
1891	27,997	135,112	1,215,028	90,606	1,468,743
1892	25,653	129,627	1,400,984	98,034	1,654,298
1893	34,969	125,688	1,512,931	100,453	1,774,041
1894	44,328	105,382	1,810,480	96,841	2,057,031
1895	34,174	75,714	1,430,144	100,442	1,640,474
1896	41,600	99,867	1,433,069	96,929	1,671,465
1897	44,103	104,966	1,473,710	115,079	1,737,858
1898	200,283	107,154	1,450,943	131,422	1,889,802
1899	207,649	125,920	1,497,297	131,916	1,962,782
1900	524,558	281,411	1,126,855	180,530	2,118,354
1901	542,659	247,595	1,125,024	182,307	2,097,585
1902	469,006	245,306	1,398,954	172,588	2,285,854
1903	329,207	222,997	935,246	111,695	1,599,145

In the above return of bunker coal there is other coal besides Pocahontas. The falling off in the tide water local and foreign business of the Pocahontas coal was due to the Pennsylvania Railroad interest, which dominated the management of the Norfolk and Western, and neglected the eastern market for the more remunerative field in the west. The imposition of a charge of $4 per ton for bunkers drove away many customers of American coal to foreign coaling stations. The exports were to West Indies, Cuba, Mexico, Philippine Islands, Central and South America, Italy, Japan, China, and Bermuda; 49,395 tons of coke were exported to Mexico.

This year saw the breaking up of the old monopoly in the Pocahontas field. Formerly one firm managed at least nine-tenths of the product; now it has not more than half, and other firms are offering a coal as satisfactory to the trade, while the Clinch Valley, Thacker, and other fields have displaced nearly a third of the Pocahontas trade at tide water.

The table following shows the countries to which coal was exported from Norfolk in 1903, and the quantities shipped to each.

Foreign shipments of coal and coke from Norfolk, Va., in 1903.

[Cargo coal only.]

Country.	Long tons.
Coal:	
West Indies	58,966
Cuba	50,358
Mexico	64,605
Philippine Islands	60,870
Central America	23,000
South America	40,009
Italy	2,322
Japan	10,495
China	3,900
Bermudas	1,800
Total	315,225
Coke:	
Mexico	48,900
Cuba	495
Total	49,395
Total of coal and coke	364,620

PITTSBURG, PA.

The following table, which presents the statement of the amount of coal shipped to the city of Pittsburg, and through that center to other points, has been compiled from reports made to the Geological Survey by officials of the railroads entering Pittsburg and by the United States Army officer in charge of the slack-water navigation on the Monongahela River and of the improvements under way at Davis Island dam, on the Ohio River below Pittsburg. The railroad officials furnishing the information for this report, and to whom special acknowledgment is due, are Messrs. J. G. Searles, general coal freight agent of the Pennsylvania Railroad, Philadelphia, Pa.; W. L. Andrews, assistant coal and coke agent of the Baltimore and Ohio Railroad, Pittsburg, Pa.; C. F. Perkins, general ore and coal agent, Pennsylvania lines west of Pittsburg, Pittsburg, Pa.; W. A. Terry, general freight agent, Pittsburg and Lake Erie Railroad, Pittsburg, Pa. The statistics of the movement of coal through the Monongahela locks and the Davis Island dam, on the Ohio River below Pittsburg, have been furnished by Capt. William L. Sibert, Corps of Engineers, U. S. Army. The shipments as reported from these railroad companies, added to the coal mined and shipped in the pools of the Monongahela River, show that the total movement of coal to and through Pittsburg during 1903 amounted to 31,172,614 short tons, of which approximately 15,500,000 tons were consumed either in the city or in the manufacturing establishments in the immediate vicinity. The local consumption in 1903 was about 2,550,000 short tons, or about 20 per cent more than that of 1902. The local consumption of "river" coal amounted to 6,303,365 short tons, or nearly 40 per cent of the total Pittsburg coal consumption. The largest amount of this coal is consumed along the first and second pools, where some of the largest iron and steel works in the world are located. The details of the movement of the coal in the Pittsburg coal district are shown in the following table:

Shipments of coal to and through Pittsburg in 1899, 1900, 1901, 1902, and 1903.

[Short tons.]

Transportation route.	1899.	1900.	1901.	1902.	1903.	Increase in 1903.	Decrease in 1903.
Pennsylvania R. R.:							
To Pittsburg and vicinity	1,698,240	1,792,448	2,051,361	2,062,422	1,851,348	....	211,074
To west of Pittsburg	1,459,546	1,477,277	1,407,643	1,701,431	2,211,347	509,916	....
Baltimore and Ohio R. R.:							
To Pittsburg district	546,679	481,587	464,204	580,241	442,866	....	21,375
To west of Pittsburg	950,632	990,062	1,157,966	1,231,314	1,305,565	74,251	....
Pittsburg, Cincinnati, Chicago and St. Louis R. R.	3,322,227	3,298,470	3,933,601	4,965,541	5,068,885	103,344	....
Allegheny Valley Rwy.:[a]							
To Pittsburg district	145,924	150,000	163,809	163,303	96,377	....	66,926
To west of Pittsburg	6,332	6,500	19,755	15,602	47,895	32,293	....
Pittsburg and Lake Erie R. R.:							
Local and Pittsburg	2,125,173	2,234,770	1,789,827	8,873,150	9,775,667	902,517	....
To west of Pittsburg	4,250,346	4,469,540	5,367,930				
Monongahela River locks:							
To Pittsburg district	2,360,827	3,260,393	[b]4,662,127	5,686,022	6,303,365	617,343	....
To west of Pittsburg	2,709,140	2,557,470	3,283,853	3,619,905	3,069,299	....	550,606
Total shipments	20,075,066	20,718,537	23,001,126	28,898,931	30,172,614	1,889,683	....
Approximate local consumption	9,100,000	10,700,000	9,430,000	12,950,000	15,500,000	....	....

[a] Coal originating on this road only. Does not include coal received from the Pennsylvania Railroad and forwarded over the Allegheny Valley Railway.

[b] Includes about 1,300,000 tons of coal mined in pools Nos. 1 and 2 and consumed by works along the Monongahela River.

MONONGAHELA RIVER SHIPMENTS.

Capt. William L. Sibert, Corps of Engineers, U. S. Army, in charge of the improvements on the Monongahela and Ohio rivers, reports a tonnage passing through the locks of the Monongahela River in 1903 of 9,372,664 short tons, against 9,305,927 tons in 1902. The local consumption in 1903 amounted to 6,303,365 short tons, an increase of 617,343 short tons over 1902, while the coal passing through Davis Island dam decreased from 3,619,905 tons in 1902 to 3,069,299 tons in 1903.

The total movement of coal through the Monongahela locks and Davis Island dam since 1890 is shown in the following table:

Movements of coal through Monongahela River locks and Davis Island dam, 1890-1903.

[Short tons.]

Year.	Passed through locks on Monongahela River.	Passed Davis Island dam, Ohio River, near Pittsburg. (From annual reports, Ohio River, improvement.)	Difference, approximate consumption of river coal at Pittsburg.
1890	4,652,104	3,420,357	1,231,747
1891	4,276,588	2,893,752	1,382,836
1892	3,872,340	2,299,294	1,573,046
1893	3,860,072	2,364,401	1,495,671
1894	4,649,612	2,453,787	2,195,825
1895	4,183,596	2,393,873	1,789,723
1896	5,709,252	4,102,190	1,607,062
1897	5,289,838	2,670,369	2,619,469
1898	6,120,800	2,979,494	3,141,306
1899	5,569,967	2,709,140	2,860,827
1900	5,817,863	2,557,470	3,260,393
1901	7,945,480	3,283,353	4,662,127
1902	a 9,305,927	3,619,905	5,686,022
1903	9,372,664	3,069,299	6,303,365

a The coal traffic on the Monongahela is obtained by adding to that which passes Lock No. 3, the coal mined and shipped in pools Nos. 1 and 2. In 1902 there were consumed in pools Nos. 1 and 2, 4,080,2[illegible] tons river coal; in the harbor below No. 1, including the Allegheny River, 1,605,735 tons of Monongahela River coal, a total of 5,686,022 tons.

RECEIPTS AND SHIPMENTS BY RAIL.

The following tables show the receipts and shipments of coal by the principal railroads entering the Pittsburg district during the last few years:

Receipts of coal in Pittsburg, Pa., via Pennsylvania Railroad, 1897-1903.

[Short tons.]

To—	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Pittsburg and vicinity	1,379,718	1,328,540	1,698,240	1,792,448	2,051,361	2,062,422	1,851,348
West of Pittsburg	1,206,598	1,283,052	1,459,546	1,477,277	1,407,643	1,701,431	2,211,347
Total	2,586,316	2,611,592	3,157,786	3,269,725	3,459,004	3,763,853	4,062,695

Shipments of coal over the Pittsburg, Cincinnati, Chicago and St. Louis Railroad, 1896-1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1896	2,585,547	1900	3,298,470
1897	2,369,022	1901	3,953,601
1898	2,783,816	1902	4,965,540
1899	3,322,227	1903	a 5,068,885

a The shipment to Pittsburg in 1903, 4,730,885 tons; to points beyond Pittsburg, 338,000 tons.

Shipments of coal via Allegheny Valley Railway to and through Pittsburg, Pa., 1896-1903.

[Short tons.]

Year.	Pittsburg district.	Via Pittsburg to all points.	Total.
1896	162,945	64,887	227,832
1897	125,445	20,721	146,166
1898	125,180	39,977	165,157
1899	145,924	6,332	152,256
1900 [a]	150,000	6,500	156,500
1901	163,809	19,755	183,564
1902	163,303	15,602	178,905
1903	96,377	47,895	144,272

[a] Approximate.

Shipments of coal and coke via Baltimore and Ohio Railroad to and through Pittsburg, Pa., 1897-1903.

[Short tons.]

Year.	Pittsburg district.		Via Pittsburg to all points.	
	Coal.	Coke.	Coal.	Coke.
1897	395,265	487,745	581,851	1,020,430
1898	430,139	437,343	656,345	1,610,759
1899	546,679	549,066	950,632	1,478,768
1900	481,587	578,731	999,082	1,641,767
1901	464,204	738,342	1,157,906	1,992,919
1902	580,241	497,169	1,231,314	1,542,313
1903	442,866	790,948	1,305,565	1,447,852

Shipments of coal over the Pittsburg and Lake Erie Railroad, 1896-1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1896	4,573,072	1900	6,704,310
1897	4,518,887	1901	7,157,307
1898	5,639,237	1902	8,873,150
1899	6,375,519	1903	9,775,667

Through the courtesy of Mr. J. Frank Tilley, secretary of the Pittsburg Coal Exchange, the following statistics, showing the shipments of coal by rivers from Pittsburg, Pa., the Kanawha River district in West Virginia, and the amounts sent to each, in bushels, in 1903, have been furnished for this report.

Coal shipments to points on the Ohio and Mississippi rivers in 1903.

Terminal points.	Bushels.
Pittsburg to Cincinnati district	29,018,901
Pittsburg to Louisville	13,657,330
Pittsburg to Evansville district	321,740
Pittsburg to Paducah-Cairo district	290,142
Pittsburg to St. Louis	2,781,517
Pittsburg to Memphis	1,707,157
Pittsburg to Vicksburg	1,716,764
Pittsburg to New Orleans	28,367,613
Kanawha River to Cincinnati	26,400,194
Kanawha River to Louisville	2,567,274
Ohio River tipples to Cincinnati	2,012,871
Points below Louisville, Ky., to Paducah district	790,000
Points below Louisville, Ky., to Memphis	1,437,221

CLEVELAND, OHIO.

The total receipts of coal and coke in Cleveland is reported by Mr. F. H. Scott, secretary of the chamber of commerce, to have amounted in 1903 to 6,595,587 short tons, as compared with 5,845,035 short tons in 1902. The shipments amounted to 2,839,391 short tons in 1903, against 2,380,618 tons in the preceding year. The following tables show the amounts of bituminous and anthracite coal and of coke received and shipped at Cleveland during the last five years, and the total receipts since 1888:

Coal and coke receipts and shipments at Cleveland, Ohio, 1899–1903.

RECEIPTS.

[Short tons.]

Kind.	1899.	1900.	1901.	1902.	1903.
Bituminous	4,857,295	4,136,696	3,996,493	4,949,027	5,577,964
Anthracite	202,782	138,614	326,741	158,405	254,193
Coke	484,738	394,934	601,213	737,603	763,430
Total	5,544,815	4,670,244	4,924,447	5,845,035	6,595,587

SHIPMENTS.

[Short tons.]

Anthracite by rail	41,072	15,456	18,731	6,214	6,590
Bituminous by rail	46,622	31,779	39,240	116,184	62,082
Bituminous by lake	2,171,417	2,201,828	1,787,028	2,234,029	2,752,549
Coke by rail	129,146	51,448	20,678	24,191	18,170
Total	2,388,257	2,300,511	1,865,677	2,380,618	2,839,391

Total coal receipts and shipments at Cleveland, Ohio, 1888–1903.

[Short tons.]

Year.	Receipts.	Shipments.	Year.	Receipts.	Shipments.
1888	2,044,159	1,029,735	1896	3,476,312	1,935,136
1889	1,910,000	1,125,000	1897	4,484,996	2,250,603
1890	1,960,591	1,229,056	1898	5,196,151	2,741,035
1891	3,230,153	1,559,910	1899	5,544,815	2,388,257
1892	4,261,757	1,779,573	1900	4,670,244	2,300,511
1893	4,101,498	1,330,951	1901	4,924,447	1,865,677
1894	3,221,205	1,222,225	1902	5,845,035	2,380,618
1895	3,475,571	1,271,962	1903	6,595,587	2,839,391

CHICAGO, ILL..

The following review of the coal trade of Chicago in 1903 was prepared by the Chicago Bureau of Coal Statistics and published in the Black Diamond of January 30, 1904:

Any review of the Chicago coal trade for 1903 which pretends to be accurate must be a history of extremes. At times the market on certain coals ebbed low in demand and prices tumbled. Then again unusual conditions created a shortage of supplies of certain much-needed coals and values went beyond the normal point. Notwithstanding these tendencies against stability, which were emphasized during the last year and stood out prominently when comparisons were made with 1901 but lacked the remarkable and phenomenal elasticity of prices during 1902, the coal trade was on the whole on a fairly satisfactory basis to those engaged in it as producers or shippers of this fuel.

Chicago made some surprising gains in tonnage during the year. The grand total of all lake and rail receipts of all coal and coke exceeded 11,000,000 tons. This is significant when its full force is realized. It means that the average of all coal and coke arriving in Chicago was nearly a million tons a month, a very large proportion of which went into consumption at the point where it was delivered.

The greatest extremes of conditions in the Chicago bituminous trade during the year occurred at three distinct periods. The first marked depression originated early in March and extended well into April. The inevitable reaction occurred at that time which always occurs when prices soar too high and markets are overstimulated by unusual conditions. The winter, with its shortage of anthracite originating in the strike of the year before and its shortage of bituminous coal originating in an overcrowded condition of railroad facilities, was passing away. Prices began to tumble, and coal which had been in transit from one to three months and which it had been thought was lost began to arrive. The spring opened early and domestic fires were reduced. All these conditions conspired to bring to the market a surplus of coal which could not be moved. The inexorable law of supply and demand had its way and prices fell to a point where those who had prospered in the winter lost much of their profits in making good demurrage charges and paying for coal which every day grew less in value.

The second depression in the bituminous trade occurred the latter part of August and early in September, when high-priced eastern domestic and steam coals began to suffer in competition with those produced in the western fields. Eastern producers were handicapped from the start of the new year by higher transportation rates from the mines and an increased cost of production. In some instances they helped these things along by taking an exaggerated view of the value of their coals. They increased the price at the mines, and while many of their friends remained loyal to them, others were looking more after the dollars than they were anything else, and passed them by. In consequence there was a glut, especially of West Virginia fuels, which every day grew worse, and which resulted in prices so low that it is to be hoped they will never again be reached when conditions as to transportation and production are the same.

The advent of the year 1904 was not encouraging from the standpoint of bituminous-coal interests. The usual active demand which is invariably experienced following the holidays was not in evidence, prices only recovering to the normal point. After that the tendency was gradually downward, and continued so until well into the spring of 1904.

The Chicago anthracite trade opened under conditions that were highly favorable. Owing to the strike of the year before, when the new prices became effective, April 1, all shippers were well supplied with orders, and the volume of business placed during that month was probably anywhere from four to five times the tonnage which came forward to Chicago for distribution to dealers. May was a repetition of April, and June was a repetition of May. By July, however, there began to be some cessation of orders, but the volume of business for that month and a large part of August absorbed practically all the coal that came forward.

It was not until September and October that shippers began to complain of business conditions. Then orders began to fall off and coal to accumulate, the trade having supplied itself with a sufficient tonnage to meet the first demands of winter weather. It was also in these months that "private" coal began to come forward more freely, owing to the lack of a market in the East, and this coal was sold below the circular basis.

The latter part of the year witnessed a steady demand, but there was no abnormal spurt in activity. Conservative shippers who make a study of conditions pertaining to their business feel that the severe weather this winter has been a means of partial redemption in the western anthracite trade. Had it not been for unusually low temperatures, which increased domestic consumption, some dock coal would have been carried over into the new year.

No more interesting table of anthracite receipts by lake and by rail at Chicago was ever compiled than the one for the year 1903. It shows that while the total receipts for the year were very close to those of 1901, much more coal was received in Chicago by lake than ever before in its history. In all probability the total receipts by both methods of transportation for the year would have been far heavier than they were had the anthracite companies felt confident that the western trade would absorb all the coal that was moved in this direction. As soon as the urgent demand which had been experienced the early part of the year was over, rail receipts began to diminish, and the latter half of the year they were from one-half to two-thirds of what they were for the first half. The heaviest lake receipts for any one month occurred in September, when 206,350 tons were moved by water from Lake Erie ports. The smallest receipts (for a full month) were in November, when only 81,950 tons were shipped by lake.

The heaviest rail and lake receipts combined occurred in August, when 302,261 tons were received in Chicago. The total rail and lake receipts for the year were 2,169,399 tons, which was an increase of 1,494,491 tons over 1902. The only months showing a decrease, as compared with the previous year, were January, 5,670 tons; and December, 56,090 tons. The decrease the latter month was not unexpected, as immediately upon resumption at the anthracite collieries in 1902 every effort was made to produce as much coal as possible and production was at the maximum point, while in 1903 there was a suspension throughout the whole region for part of the time, owing to an overproduction. The table showing the receipts of anthracite coal by lake and rail at Chicago is as follows:

Receipts of anthracite coal at Chicago, Ill., by lake and rail.

[Short tons.]

Month.	Anthracite by lake.		Anthracite by rail.		Total anthracite.		Increase in 1903.	Decrease in 1903.
	1902.	1903.	1902.	1903.	1902.	1903.		
January	....	....	88,258	82,588	88,258	82,588	....	5,670
February	....	....	68,974	134,698	68,974	134,698	65,724	....
March	....	....	65,445	131,553	65,455	131,553	66,098	....
April	72,692	91,785	72.685	87,382	145,377	179,167	33,790	....
May	47,118	148,201	34,245	57,042	81,363	205,243	123,880	....
June	1,000	118,146	3,289	78,993	4,289	197,139	192,850	....
July	....	140,723	2,862	68,596	2,862	209,319	206,457	....
August	....	184,750	2,773	117,511	2,773	302,261	299,488	....
September	....	206,350	7,106	61,695	7,106	268,045	260,939	....
October	....	190,039	6,228	55,564	6,228	245,603	239,375	....
November	50,841	81,950	21,071	57,612	71,912	139,562	67,650	....
December	53,451	14,362	78,860	59,859	130,311	74,221	....	56,090
Total	225,102	1,176,306	451,806	993,093	674,908	2,169,399	1,494,491	....

The following table shows the receipts of bituminous coal and coke at Chicago from 1899 to 1903, inclusive:

Receipts of bituminous coal and coke at Chicago, Ill., for five years, 1899–1903.

[Short tons.]

State from which received.	1899.	1900.	1901.	1902.	1903.	Increase in 1903.	Decrease in 1903.
Pennsylvania	[a] 516,087	564,833	525,571	487,134	617,521	130,387	....
Ohio	550,157	547,425	492,701	616,335	666,265	49,930	....
West Virginia and Kentucky	805,122	973,982	1,024,979	969,132	908,154	....	60,978
Illinois	2,618,309	2,662,986	2,427,092	2,958,493	4,301,803	1,343,310	....
Indiana	1,973,831	2,207,396	2,165,549	2,403,519	2,610,716	207,197	....
By lake	....	....	51,240	63,106	85,164	22,058	....
Total bituminous coal	6,463,506	6,956,622	6,687,132	7,497,719	9,189,623	1,691,904	....
Coke	520,558	613,842	594,686	602,740	591,125	....	11,615

[a] Receipts by lake, included in this amount, were 75,277 tons.

The total receipts and shipments of coal and coke at Chicago during the last three years were as follows:

Receipts and shipments of coal and coke at Chicago, Ill., in 1901, 1902, and 1903.

[Short tons.]

Year.	Anthracite.		Bituminous.		Coke.	
	Receipts.	Shipments.	Receipts.	Shipments.	Receipts.	Shipments.
1901	2,192,545	514,639	6,687,132	1,239,264	594,686	397,665
1902	674,908	199,735	7,497,719	1,830,615	602,740	416,178
1903	2,169,399	606,711	9,189,623	2,184,193	591,125	375,942

MILWAUKEE, WIS.

The following review of the coal trade of Milwaukee has been furnished by Mr. William J. Langson, secretary of the chamber of commerce:

The coal receipts at Milwaukee in 1903 passed the 3,000,000 point, showing the remarkable increase of 1,382,882 tons in a year. This, however, was greater than the normal increase, owing to the complete depletion of reserve stocks during the coal famine of the preceding year.

The remarkable feature of the year's business was the comparatively small quantity of coal shipped westward from this port, viz, 650,430 short tons, only 1,182 tons more than the previous year. This would indicate that over 2,000,000 tons of coal were required for local consumption in Milwaukee, unless the shipments as reported daily by the railroads to the chamber of commerce were incomplete, which is not likely. An omission might occur once or twice, but is not likely to occur so often as to materially affect the year's shipments.

The coal was undoubtedly delivered on contracts to local manufacturers, and left the yards with a barely sufficient supply to carry them through the winter. At the present writing (June, 1904) dealers are sweeping up their yards to meet the local demand for anthracite, and unless the tie up of lake commerce is broken soon we shall find ourselves entering upon the next winter with prospects of another coal famine.

The total receipts of anthracite and bituminous coal in the last five years is shown below:

Total receipts of coal at Milwaukee, Wis., for six years, 1898–1903.

Kind.	1898.	1899.	1900.	1901.	1902.	1903.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Anthracite	768,150	922,321	639,100	845,687	[a] 172,676	946,596
Bituminous	920,911	997,543	1,169,493	1,107,802	1,468,419	1,702,755
Total	1,689,061	1,919,864	1,808,593	1,953,489	1,641,095	2,649,351

[a] Strike.

A comparison of the receipts of coal at Milwaukee, by decades, with those of 1901, 1902, and 1903 is interesting, and is shown in the following table:

Growth of the coal trade of Milwaukee, Wis., 1868–1903.

Year.	Receipts.
	Short tons.
1868	92,992
1878	239,667
1888	1,122,243
1898	1,689,061
1901	1,953,489
1902	1,641,095
1903	3,023,977

The tables following exhibit the details of receipts and shipments at Milwaukee for a series of years:

Receipts of coal at Milwaukee, Wis., for six years, 1898–1903.

[Short tons.]

Source.	1898.	1899.	1900.	1901.	1902.	1903.
By lake from—						
Buffalo	624,616	797,006	515,545	717,356	132,803	914,901
Erie	134,774	273,779	222,789	259,841	141,130	153,325
Oswego	37,000	2,590	1,257	2,365	....	7,003
Cleveland	341,898	354,900	277,786	191,785	354,485	436,834
Ashtabula	115,579	94,284	149,208	92,698	97,378	230,726
Lorain	11,855	24,177	25,222	67,214	69,132	104,549
Sandusky	29,572	27,991	93,686	85,488	131,285	213,124
Toledo	243,818	131,047	313,393	315,036	416,057	477,950
Charlotte	1,275	613	....	....	....	....
Fairport	37,094	38,530	22,408	4,320	20,690	65,981
Ogdensburg	1,133	....	....	1,368	4,083	....
Huron, Ohio	4,159	5,400	30,148	13,950	2,528	23,046
Other ports	4,192	25,450	....	13,600	4,400	21,912
Total, lake	1,586,965	1,775,767	1,651,442	1,765,021	1,373,971	2,649,351
By railroad	102,096	144,097	157,151	188,468	267,124	374,626
Receipts	1,689,061	1,919,864	1,808,593	1,953,489	1,641,095	3,023,977

Shipments of coal from Milwaukee, Wis., for six years, 1898–1903.

[Short tons.]

Shipped by—	1898.	1899.	1900.	1901.	1902.	1903.
Chicago, Milwaukee and St. Paul Rwy	398,668	327,369	378,901	459,252	376,710	350,505
Chicago and Northwestern Rwy	245,472	210,495	241,992	255,948	243,535	259,941
Wisconsin Central R. R	31,538	35,851	47,629	56,834	28,823	33,339
Lake	4,180	....	5,950	4,616	180	6,645
Total	679,858	573,715	674,472	776,650	649,248	650,430

Receipts of coal at Milwaukee, Wis., by lake and rail annually, 1863–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1863	43,215	1884	704,166
1864	44,503	1885	775,750
1865	36,369	1886	759,681
1866	66,616	1887	842,979
1867	74,568	1888	1,122,243
1868	92,992	1889	960,678
1869	87,690	1890	996,657
1870	122,865	1891	1,156,088
1871	175,526	1892	1,374,414
1872	210,194	1893	1,249,732
1873	229,784	1894	1,337,046
1874	177,655	1895	1,446,423
1875	228,674	1896	1,587,795
1876	188,444	1897	1,555,808
1877	264,784	1898	1,689,061
1878	239,667	1899	1,919,864
1879	350,840	1900	1,808,593
1880	368,568	1901	1,953,489
1881	550,027	1902	1,641,095
1882	593,842	1903	3,023,977
1883	612,584		

Freight rates from Buffalo to upper lake ports in 1903, by months.

Month.	Chicago.	Milwaukee.	Duluth and Superior.
	Cents.	*Cents.*	*Cents.*
April	50	50	40
May	50	50	40
June	50	50	40
July	40–50	40–50	30–40
August	50	50	40
September	50	50	30–40
October	40	40–50	30
November	35–50	35–75	30–75
December	50	75	75

Yard prices per ton of coal at Milwaukee, Wis., during the year 1903, reported by Whitnall Coal Company.

[Free on board cars.]

Month.	House use.		Cannel, Kentucky.	Steam coal.	
	Pittston anthracite.	Egg, Pocahontas.		Hocking.	Pittsburg.
January	$6.50	$6.50	$5.60	$3.50	$3.55
February	6.50	6.50	5.60	3.50	3.55
March	6.50	6.50	5.60	3.50	3.55
April	6.00	6.50	5.60	3.50	3.55
May	6.10	5.00	5.60	3.75	3.75
June	6.20	5.00	5.60	3.75	3.75
July	6.30	5.00	5.60	3.75	3.75
August	6.40	5.00	6.10	3.75	3.75
September	6.50	5.00	6.10	4.00	3.75
October	6.50	5.00	6.10	4.00	3.75
November	6.50	5.00	6.10	4.00	3.75
December	6.50	5.00	6.10	4.00	3.75

CINCINNATI, OHIO.

Mr. Charles B. Murray, superintendent of the chamber of commerce, has furnished the following review of the coal trade of Cincinnati:

The receipts of coal at Cincinnati in 1903, as indicated by the records of the chamber of commerce, reached the high record of 112,351,891 bushels. This compares with 104,600,593 for 1902, and an annual average of 93,102,565 for five years prior to 1903. Referring to the figures given a year ago, and for recent years previously, it is proper to say that there has been found occasion for revision of the records of receipts by railroads, with the result of enlargement of indicated quantities through such channels, for five years prior to 1903, or since 1897. The tables are corrected accordingly, and are more complete than heretofore in the exhibits and comparisons.

In the effort to indicate the quantity of coal arriving from the Kanawha district it is not possible to be exact, and the method of reaching results is to secure estimates as to the proportion of all the rail receipts properly to be credited to the Kanawha district.

The receipts of coal in 1903 by river were 49.34 per cent, and by rail 50.66 per cent of the total. For the past five years river receipts represent an average of 56.60 per cent and rail receipts 43.40 per cent.

Coal shipments in 1903 made a high record, due to enlarged movement by rail, the total being 39,422,750 bushels, compared with 36,637,747 for 1902, and an annual average of 22,086,396 for five years prior to 1903. River shipments the past year were 2,787,000 bushels, and rail shipments 36,635,750 bushels.

The local market was fairly steady during the year, with ample supplies available. For several months there were strikes in some of the mines of the West Virginia district, interrupting operations, but not seriously affecting the resources for this market. The arrivals of coal by river were considerably smaller than for the preceding year, and those by rail were decidedly increased.

The net supply of coal at Cincinnati in 1903, representing the difference between receipts and shipments, was 72,929,000 bushels. There was a much larger quantity on hand, afloat, and in the yards and sidings at the close of the year than at the beginning, so that the actual consumption for the year would represent considerably less than the net supply, but was probably equal to or in excess of 65,000,000 bushels. The local consumption in late years appears to have been pretty evenly divided between industrial and household requirements.

For the year 1903 the local gas works consumed 244,527 tons of 2,000 pounds, or 6,790,000 bushels. There were sent out from the works 1,578,665,000 cubic feet of gas, and the product of electric current represented 25,115,969 kilowatts.

Prices of coal in the Cincinnati market in 1903 were as follows: By river, afloat, from Pittsburg district, 10 cents per bushel to March 31, 9 cents subsequently to end of the year; from Kanawha district, 9 cents first three weeks in January, 10 cents next three weeks, 9 to 10 cents until end of April, 8½ to 10 cents to September 22, and 9 cents remainder of the year.

Prices of coal delivered to consumers in 1903 were the same for Pittsburg and Kanawha product, as follows, per ton of 2,000 pounds: To close of April, $4; remainder of the year, $3.50.

The average price of coal afloat at Cincinnati in 1903 for both Pittsburg and Kanawha product was 9.25 cents, compared with 7.92 for Pittsburg and 7.86 for Kanawha, for 1902. Annual averages for a series of years appear in a table elsewhere in this report.

The price of anthracite delivered to consumers was $10 per ton to middle of February, $9 to end of March, $7.50 for remainder of the year, averaging $8 for the year, compared with $9 for 1902, and an annual average of $6.55 for five years prior to 1902.

The following table indicates the quantities of coal received at Cincinnati since 1872 and the sources from which shipped:

Receipts of coal at Cincinnati, Ohio, since September 1, 1872.

[Bushels.]

Year.	Pittsburg (Youghiogheny).	Kanawha by river.	Ohio River.	Cannel.	Anthracite.	Other kinds.	Total.
1872–73	24,962,373	....	a11,075,072	1,162,052	75,000	....	37,274,497
1873–74	24,014,681	....	a10,398,153	710,000	112,000	....	35,234,834
1874–75	24,225,002	4,476,619	4,277,327	565,352	248,750	1,597,260	35,390,310
1875–76	27,017,592	6,004,675	4,400,792	409,358	282,578	2,068,322	40,183,317
1876–77	28,237,572	3,631,823	5,141,150	322,171	376,125	1,913,793	39,622,634
1877–78	26,743,055	6,386,623	3,288,008	380,768	439,350	1,654,425	38,892,229
1878–79	20,769,027	6,134,039	4,068,452	338,549	768,750	2,136,850	34,210,667
1879–80	31,750,968	8,912,801	4,268,214	202,489	712,075	2,351,699	48,198,246
1880–81	23,202,084	10,715,459	3,151,934	67,684	770,525	2,336,752	40,244,438
1881–82	37,807,961	13,950,802	3,560,881	77,336	779,925	3,090,715	59,267,620
1882–83	33,895,064	13,260,347	3,309,534	180,621	977,250	2,997,216	54,620,032
1883–84	32,239,473	15,926,743	2,956,688	293,010	1,085,350	3,910,795	56,412,059
1884–85	32,286,133	14,588,573	3,007,078	314,774	1,257,900	2,683,864	54,138,322
1885–86	34,933,542	17,329,349	939,746	205,717	1,287,925	2,720,250	57,416,529
1886–87	37,701,094	20,167,875	338,435	129,503	1,314,775	3,693,850	63,345,532
1887–88	41,180,713	20,926,596	1,533,358	26,098	1,328,225	5,710,649	70,705,639
1888–89	36,677,974	23,761,853	544,940	12,129	1,020,525	3,075,000	65,092,421
1889–90	42,601,615	19,221,196	454,385	....	1,001,175	4,709,775	67,988,146
1890–91	43,254,460	19,115,172	1,479,670	15,111	1,118,671	7,362,698	72,345,782
1891, 4 months	13,766,390	6,288,442	234,940	....	402,528	4,437,139	25,129,439
1892 b	42,272,348	19,214,704	768,588	....	1,268,170	13,335,006	76,858,816
1893	28,643,562	24,971,261	405,202	....	759,626	25,832,374	80,612,025
1894	40,156,667	16,398,039	158,334	....	661,548	19,083,527	76,458,115
1895	26,675,823	15,106,095	14,400	....	1,227,000	27,119,823	70,143,141
1896	36,696,759	22,015,133	130,217	....	1,171,000	19,676,000	79,689,109
1897	35,040,790	17,941,769	60,217	....	1,251,250	24,468,000	78,762,026
1898	41,271,142	19,949,098	95,590	....	948,125	26,014,800	88,278,755
1899	33,339,381	18,987,364	29,533	....	1,291,250	30,172,800	83,820,328
1900	19,066,472	24,586,857	917,206	....	437,500	28,341,000	73,349,035
1901	22,379,828	27,516,166	1,219,387	....	632,500	39,643,100	91,390,981
1902	37,506,783	21,035,945	1,487,315	....	293,750	44,276,800	104,600,593
1903	27,018,901	26,400,194	2,012,871	....	510,625	56,409,300	112,351,891

a Includes Kanawha River coals.

b Calendar years since 1892.

NOTE.—The "Other kinds" in above table includes 30,845,000 bushels of Kanawha by rail in 1903, and Kanawha rail coal previously.

A summary of the movement of coal at Cincinnati during the last two years is given in the following table:

Summary of coal movements at Cincinnati, Ohio, in 1902 and 1903.

[Bushels.]

Details.	1903.	1902.	Details.	1903.	1902.
Total received	112,351,891	104,600,593	Anthracite	510,625	293,750
Pittsburg	27,018,901	37,506,783	Total:		
Ohio River	2,012,871	1,487,315	By river	55,431,966	60,080,043
Kanawha:			By rail	56,919,925	44,570,550
By river	26,400,194	21,035,945	Shipped:		
By rail	30,844,800	28,780,000	By river	2,787,000	6,113,597
Total Kanawha	57,244,994	49,815,945	By rail	36,635,750	30,524,150
Other kinds by rail	25,564,500	15,496,800	Total shipped	39,422,750	36,637,747

The yearly range and average prices of Pittsburg coal, afloat and delivered, per bushel, based on weekly records, compare for a series of years as shown in the following compilation:

Yearly range and average prices for Pittsburg coal at Cincinnati, Ohio, 1888–1903.

[Cents per bushel.]

Year.	Afloat.			Delivered.		
	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.
1888–89	6	8⅛	6.71	9	11⅜	9.95
1889–90	6	8	6.78	9	10¾	9.69
1890–91	6⅛	8⅛	7.28	10	10¾	10.24
1892	6⅛	8⅛	7.49	9	12⅛	10.36
1893	6⅛	8¾	7.58	9	19¾	11.04
1894	5¼	9	6.34	7½	10¾	9.11
1895	5⅛	6⅛	6.00	8⅛	10⅝	9.00
1896	5⅛	6	5.73	8⅛	9	8.40
1897	5⅛	5⅜	5.70	5⅜	10¾	8.10
1898	5	6	5.66	7½	9	8.05
1899	4⅛	7⅛	5.30	8⅛	11⅜	9.50
1900	7⅛	8	7.50	10¾	11¾	10.90
1901	6⅛	8	7.50	9	10⅜	10.55
1902	6⅛	10	7.92	10	14⅛	11.75
1903	9	10	9.25	12⅛	14⅛	13.18

Coal from the Kanawha and other West Virginia regions sells at the same, or about the same, prices as are obtained for the product from the Pittsburg district. Sales afloat are on the bushel basis, 72 pounds; sales delivered are on the ton basis, 2,000 pounds, and represent screened or lump grade.

The receipts of coke for the year were 4,473,900 bushels, and the quantity locally manufactured was 6,502,890 bushels, making a total of 10,976,790 bushels, compared with 13,883,600 bushels the preceding year. For city manufacture the average price for the year was 13 cents per bushel; of gas house, 12 cents; of Connellsville, $6.50 per ton.

ST. LOUIS, MO.

The following summary of the coal trade of St. Louis has been prepared for this report by Mr. William Flewellyn Saunders, secretary and general manager of the Business Men's League of that city:

The production of soft coal and coke in the St. Louis district increased largely in 1903 over the product of 1902, all of it being used in the city. The receipts of eastern anthracite were much below the demand, the shipping to the West not having been fully resumed after the strike. Prices, however, ruled much lower than in 1902, the shortage of anthracite being balanced by plenty of soft coal and coke.

Coal operations in the Illinois fields near St. Louis, known as the

St. Louis district, are being conducted with regard to the demand, and prices bid fair to rule very regularly. The large operations in the new Leiter coal fields will be a factor in the coal situation here in the future and are being watched with great interest by miners and dealers.

The use of gas as household fuel has increased noticeably in St. Louis in two years, and this must undoubtedly be treated in calculation about the fuel situation hereafter. The introduction of gas as fuel in the household results in the use of more fuel, not in the substitution of the one kind of fuel for the other. That has been demonstrated in St. Louis as well as elsewhere.

Coal prices at St. Louis, Mo., during 1902 and 1903.

Kind.	1902.			1903.		
	Highest.	Lowest.	Closing.	Highest.	Lowest.	Closing.
Standard Illinois lump coal	$3.30	$1.40	$2.40	$2.30	$1.60	$2.00
High-grade Illinois lump coal	3.30	1.80	2.65	3.05	2.10	2.80
Anthracite, large	9.75	6.10	8.80	7.15	6.65	7.15
Anthracite, small	10.00	6.35	9.05	7.40	7.15	7.40
Connellsville coke	14.30	6.30	9.30	9.00	5.25	5.25
New River coke	14.30	5.80	9.30	9.00	5.25	5.25
Kentucky coke	6.30	3.80	5.30	5.00	3.50	3.50
Gas coke	7.50	3.25	7.50	5.50	4.50	5.50

Coal and coke receipts at St. Louis, Mo., 1892–1903.

Year.	Soft coal.	Hard coal.	Coke.
	Bushels.	*Tons.*	*Bushels.*
1892	82,302,228	187,327	8,914,400
1893	87,769,375	173,653	7,807,000
1894	74,644,375	186,494	6,365,900
1895	88,589,985	207,784	7,130,300
1896	87,677,600	218,955	5,395,900
1897	83,730,980	172,933	5,671,350
1898	83,562,450	225,616	7,762,250
1899	103,115,730	292,118	6,795,100
1900	104,317,650	180,550	7,942,900
1901	118,860,775	200,797	11,746,592
1902	130,145,350	60,944	8,180,000
1903	159,221,625	165,920	11,414,720

SAN FRANCISCO, CAL.

Mr. J. W. Harrison, in his annual report to the coal trade of San Francisco, states that the quantity of coal imported during 1903 was 230,044 tons less than 1902, as shown in the table below. This can not be accepted as the amount of fuel necessary to fill the requirements, as the quantity of fuel oil produced last year was 60 per cent in excess of the production in 1902. Hence the showing made for the coal consumption is not a discouraging one for manufacturing interests locally. During the early portion of 1903 labor disturbances developed in the British Columbia collieries. These were not amicably compromised for some considerable time, as the manager of the Wellington collieries showed a disposition to maintain what he considered his rights rather than make concessions, although at a serious loss to himself. The laborers finally yielded. The abrogation of the duty of 67 cents per ton on Australian and British Columbia coals has given a marked advantage for those products, and has aided in giving large consumers here a pronounced benefit.

The present position is a complicated one. The outlook for low-priced Australian coal is discouraging, partially because the inducements for carriers to come here are anything but favorable and partially because outward freights on grain from here are exceedingly low, while from Australia they are fully 50 per cent higher than from here. The quantity of coal of all grades on hand here at the close of the year was small. There are factors now existing which may create a very generous demand for fuel in the near future, principally the requirements of the Government for Panama and adjacent ports, but the market is in a very uncertain condition. The control of the local coal market is in a few hands, which will assure high figures for 1904. The marked difference between the prices of domestic grades and ordinary steam coals is likely to be sustained.

The various sources from which the coal supplies of California have been derived are as follows:

Sources of coal consumed in California, 1899–1903.

[Short tons.]

Source.	1899.	1900.	1901.	1902.	1903.
British Columbia	623,132	766,917	710,330	591,732	289,890
Australia	139,333	178,563	175,959	197,828	276,186
England and Wales	95,263	54,099	52,270	95,621	61,580
Scotland	None.	None.	None.	3,600	3,495
Eastern (Cumberland and anthracite)	38,951	17,319	27,370	24,133	13,262
Seattle (Franklin, Green River, etc.)	271,694	250,590	240,574	165,237	127,819
Carbon Hill, South Prairie, etc	355,756	418,052	433,817	209,358	256,826
Mount Diablo, Coos Bay, and Tesla	189,507	160,915	143,318	111,209	84,277
Japan and Rocky Mountains	28,390	42,673	51,147	47,380	102,219
Total	1,740,027	1,889,128	1,834,785	1,445,598	1,215,554

It is necessary to include the deliveries at the ports of Los Angeles and San Diego to arrive at an accurate statement of the consumption of coal in the State. These are added in the above-named sources of supply. The total amount received by water at these two ports in

1903 aggregated 69,248 tons, as compared with 126,356 tons in 1902, 240,777 short tons in 1901, 165,965 short tons in 1900, 184,747 short tons in 1899, and 154,402 short tons in 1898.

SEATTLE, WASH.

Mr. Lovett M. Wood, editor of the Trade Register, has compiled, from records furnished by the Northern Pacific and Great Northern railroads and the Pacific Coast Company the following statement of the coal receipts at Seattle by months and mines for the calendar year 1903. The combined receipts in short tons, by months, were as follows:

Receipts of coal at Seattle, Wash., 1903, by months.

Month.	Quantity.	Month.	Quantity.
	Short tons.		*Short tons.*
January	78,215	August	83,961
February	78,818	September	114,807
March	84,263	October	85,407
April	74,440	November	83,563
May	86,097	December	78,398
June	78,187	Total	1,001,798
July	75,672		

The receipts at Seattle during 1902 amounted to 859,301 tons, showing an increase for 1903 of 145,497 tons.

The exports, which included 7,618 tons shipped to British Columbia, against 2,820 tons imported from that province, show a decline of 13,642 tons, although Seattle received during the year 142,497 tons more than in 1902. Local consumption and the extended use of oil as fuel for steamers can probably be chargeable with causing this condition.

It will be noted that the receipts have more than doubled in the last ten years, and the exports are larger than the receipts were a decade ago. The exports vary only slightly on account of the southern market's requirements and peculiar conditions. With oil coming into more general use in California, and even at home, and the new arrangements made with the northern collieries, together with the restricted demands of foreign steamship lines engaged in oriental trade and the Australian coal already billed for this coast, it would appear as though the mines of the State of Washington would this year have to depend for increased output upon the enlargement of industrial institutions, local shipping, and home consumption.

The State of Washington coal mines had an output in 1903 of 3,190,477 tons, against 2,498,177 tons in 1902, and 2,400,276 tons in 1901. King County is the second largest producer, being close to Kittitas County.

Shipments of coal from the mines and eastern points to Seattle, Wash., in 1903.

[Short tons.]

Mine.	Quantity.	Mine.	Quantity.
Black Diamond	236,049	Enumclaw	29
Newcastle	118,494	Staples	21
Franklin	71,116	Douty	11,597
Fulton	71,584	Kanasket	220
Lawson	71,196	Ravensdale	115,937
Gem	47,603	Melmont	10,618
Issaquah	37,034	Rices Point	40
Renton	92,662	Horr, Mont	20
Sunset	1,138	Niblock's Spur	482
Fairfax	5,068	Burnett	8,307
Roslyn	72,483	Gibbons	270
Cle Elum	4,820	Blue Canyon	296
Wilkeson	17,288	Henry's	5,590
West Superior	589	Shoreham, Minn	64
Duluth	1,004	Total	1,001,798
Gladstone	184		

Exports of coal at Seattle, Wash., in 1903, by months.

[Short tons.]

Month.	Exports.[a]	Month.	Exports.[a]
January	44,850	August	38,041
February	31,718	September	38,215
March	42,562	October	34,717
April	34,782	November	30,121
May	36,328	December	28,312
June	54,330	Total	463,186
July	49,215		

[a] Foreign and domestic points (mostly San Francisco, Cal.).

Receipts and exports of coal at Seattle, Wash., 1890–1903.

[Short tons.]

Year.	Receipts.	Exports.[a]	Year.	Receipts.	Exports.[a]
1890	487,215		1897	472,311	287,883
1891	421,587		1898	622,284	378,578
1892	416,174		1899	821,365	444,428
1893	461,034	342,114	1900	909,322	478,562
1894	437,939	318,670	1901	991,788	482,679
1895	363,979	257,739	1902	859,301	476,828
1896	425,108	194,771	1903	1,001,798	463,186

[a] Foreign and domestic points (mostly San Francisco, Cal.).

PRODUCTION OF COAL BY STATES.

Including Alaska, there were thirty States and Territories which contributed to the total coal production of the United States in 1902 and 1903. Of these there were eight whose output was less than 1,000,000 tons; twelve produced between 1,000,000 and 5,000,000 tons each: four, between 5,000,000 and 10,000,000 tons each; two, Alabama and Indiana, produced over 10,000,000 of tons, and four exceeded 25,000,000 of tons each. Of these latter, one, Pennsylvania, produced over 175,000,000 tons. Of the thirty coal-producing States and Territories thirteen are east and seventeen west of the Mississippi River. Of the thirteen States east of the Mississippi River there were six located north of the Ohio and Potomac rivers, producing 256,527,929 short tons, or 71.8 per cent of the total. The seven Southern States produced 57,213,168 short tons, or 16 per cent of the total. The seventeen States and Territories west of the Mississippi River produced 43,615,319 short tons, or 12.2 per cent of the total.

In the following tables are shown the statistics of production in the States east of the Mississippi River and divided by the Ohio and Potomac rivers, and in the States and Territories west of the Mississippi River. The figures are given for the years 1880, 1890, 1900, and 1903:

Coal production in States north of Ohio and Potomac rivers in 1880, 1890, 1900, and 1903.

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	2,585,587	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.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Illinois	25,767,981	$26,927,185	36,957,104	$43,196,809
Indiana	6,484,086	6,687,137	10,794,692	13,244,817
Maryland	4,024,688	3,927,381	4,846,165	7,189,784
Michigan	849,475	1,259,683	1,367,619	2,707,527
Ohio	18,988,150	19,292,246	24,838,103	31,932,327
Pennsylvania:				
Anthracite	57,367,915	85,757,851	74,607,068	152,036,448
Bituminous	79,842,326	77,438,545	103,117,178	121,752,759
Total	193,324,621	221,290,028	256,527,929	372,060,471

Coal production in States south of Ohio and Potomac rivers, 1880, 1890, 1900, and 1903.

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.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Alabama	8,394,275	$9,793,785	11,654,324	$14,246,798
Georgia	315,557	370,022	416,951	521,459
Kentucky	5,328,964	4,881,577	7,538,032	7,979,342
North Carolina	17,734	23,447	17,309	25,300
Tennessee	3,509,562	4,008,082	4,796,004	5,979,830
Virginia	2,393,754	2,123,222	3,451,307	3,302,149
West Virginia	22,647,207	18,416,871	29,337,241	34,297,019
Total	42,607,053	39,612,006	57,213,168	66,351,897

Coal production in States west of Mississippi River, 1880, 1890, 1900, and 1903.

State or Territory.	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

Coal production in States west of Mississippi River, 1880, 1890, 1900, and 1903—Cont'd.

State or Territory.	1900.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Arkansas	1,447,945	$1,653,618	2,229,172	$3,360,831
California	172,908	540,031	*a* 105,420	301,318
Colorado	5,244,364	5,858,036	7,423,602	9,150,943
Idaho	10	50	4,250	13,250
Indian Territory	1,922,298	2,788,124	3,517,388	6,386,463
Iowa	5,202,939	7,155,341	6,419,811	10,563,910
Kansas	4,467,870	5,454,691	5,839,976	8,871,953
Missouri	3,540,103	4,280,328	4,238,586	6,834,297
Montana	1,661,775	2,713,707	1,488,810	2,440,846
Nebraska	....	....	....	....
New Mexico	1,299,299	1,776,170	1,541,781	2,105,785
North Dakota	129,883	158,348	278,645	418,005
Oregon	58,864	220,001	91,144	221,031
Texas	968,373	1,581,914	926,759	1,505,333
Utah	1,147,027	1,447,750	1,681,409	2,026,038
Washington	2,474,093	4,700,068	3,193,273	5,380,679
Wyoming	4,014,602	5,457,953	4,635,293	5,731,281
Total	33,752,353	45,786,130	43,615,319	65,312,013

a Includes Alaska.

The production of coal in the several States and Territories in 1903 and preceding years is discussed more in detail in the following pages.

ALABAMA.

Total production in 1903, 11,654,324 short tons; spot value, $14,246,798.

Compared with 1902, the production of coal in Alabama in 1903 shows an increase of 1,299,754 short tons, or 12.6 per cent, in quantity, and of $1,827,132, or 14.7 per cent, in value. In 1902 the output of the State exceeded for the first time in its history a total of 10,000,000 short tons. The record for 1903 shows a continuation of the steady progress which Alabama has shown in industrial development during the last thirty years, and the large increase over the production of 1902 was made notwithstanding the fact that work was considerably interrupted by strikes among the mine workers. These difficulties were finally adjusted by a board of arbitration consisting of two members selected by the operatives and two selected by the miners, and presided over by Hon. George Gray, who was chairman of the Anthracite Coal Strike Commission.

The census report of 1840 gives the production of coal in Alabama for that year at 946 short tons. The next record we have is for 1860, when the output amounted to 10,200 short tons. It was the smallest production reported in that year from any coal-producing State. Twenty years later, in 1880, the production of Alabama amounted to 323,972 short tons, the State ranking fourteenth among the coal-producing States. In 1882 the production of coal in Alabama was greatly stimulated by the discovery of rich iron-ore deposits in the vicinity of Birmingham, and the "Birmingham boom" became a notable event in the history of the State's industrial development. By 1885 the production had increased to nearly 2,500,000 short tons. It was in this year that the "boom" collapsed, and in 1886 the coal production decreased to 1,800,000 short tons. By the close of 1887 the conditions had settled down to a conservative and rational basis, and since that time the coal production of Alabama has increased almost uninterruptedly to the close of 1903. In 1890 the production amounted to 4,090,409 short tons. The State had now become fifth in the Union in the production of coal, and it has maintained that position continuously since that date, being outranked only by Pennsylvania, Illinois, West Virginia, and Ohio. The production of 1900 was a little more than double that of ten years previous, and amounted to 8,394,275 short tons. From 1894 to 1903 the coal production has increased each year without exception.

The average price per ton for all the coal produced in Alabama in 1903 was $1.22, an increase of 2 cents over the price per ton for 1902, and the highest point reached in a period of sixteen years.

The total number of men employed in the coal mines of Alabama during 1903 is reported as 21,438, as compared with 16,439 in 1902. The average amount of working time made by each employee in 1903 was 228 days of nine hours, as compared with 256 for the preceding year. The average number of tons mined for each employee in 1903 was 543.6 against 630 short tons in 1902. The average tonnage per day per man in 1903 was 2.38, as compared with 2.46 in 1902 and with 2.22 in 1901. This shows a considerable decrease in the total efficiency per man, as compared with 1902, but a considerably better showing than was made in 1901.

In the following tables is presented a statement of the production of coal in Alabama in 1902 and 1903, by counties, showing the distribution of the product for consumption, with the value and the statistics of labor employed for each year:

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	261	208
Jefferson	3,410,698	56,050	160,873	2,227,915	5,855,536	6,975,929	1.19	290	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	1.18	228	3,388
Winston	26,686	2,000	....	....	28,686	41,250	1.44	134	174
Blount, Cullman, and Marion	253,178	....	....	....	253,178	332,608	1.31	283	565
Total	7,271,146	78,903	244,223	2,760,298	10,354,570	12,419,666	1.20	256	16,439

Coal production of Alabama in 1903, 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	1,558,202	40,816	51,649	490	1,651,157	$2,278,061	$1.38	232	2,380
Etowah	119,680	....	150	....	119,830	191,728	1.60	289	211
Jefferson	3,563,160	37,329	181,979	2,412,364	6,194,832	7,346,973	1.19	226	11,725
St. Clair	124,193	734	10,255	17,131	152,313	210,610	1.38	217	461
Shelby	225,776	2,589	12,597	....	240,962	371,872	1.54	211	550
Tuscaloosa	303,089	36,715	12,048	258,540	610,392	706,285	1.16	214	1,295
Walker	2,149,851	11,397	29,615	174,522	2,365,385	2,726,550	1.15	234	3,949
Winston	50,716	25	100	....	50,841	70,750	1.39	234	143
Other counties[a]	252,840	8,596	6,876	300	268,612	344,019	1.28	244	704
Total	8,347,507	138,201	305,269	2,863,347	11,654,324	14,246,798	1.22	228	21,438

[a] Blount, Cullman, Dekalb, Jackson, and Marion.

In the following table is shown the production, by counties, during the last five years, and the increase and decrease in 1903 as compared with 1902. Each of the more important producing counties, with the exception of St. Clair, shows increased production in 1903. The total increase of 1,299,754 is a little greater than the increase of 1902 over 1901.

Coal production of Alabama, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase in 1903.	Decrease in 1903.
Bibb	912,263	964,785	1,258,853	1,487,407	1,651,157	163,750	....
Blount, Cullman	15,724	18,572	143,697	a 253,178	a 260,802	7,624	....
Etowah	9,578	20,855	93,591	101,790	119,830	18,040	....
Jefferson	4,878,696	5,255,296	5,549,715	5,855,536	6,194,832	339,296	....
St. Clair	52,252	156,270	140,816	156,243	152,313	....	3,930
Shelby	86,928	135,832	149,132	136,043	240,962	104,919	....
Tuscaloosa	325,461	268,422	374,718	431,711	610,392	178,681	....
Walker	1,249,294	1,489,380	1,284,025	1,903,976	2,365,385	461,409	....
Winston	a 28,220	a 49,863	69,505	28,686	50,841	22,155	....
Small mines	35,000	35,000	35,000	(b)	7,810	7,810	....
Total	7,593,416	8,394,275	9,099,052	10,354,570	11,654,824	c 1,299,754	....

a Includes production of Marion County.
b Small-mine production included in county distribution.
c Net increase.

In the following table is presented the distribution of the coal production of Alabama for fifteen years. In this statement the amount of coal 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 of the coal which finally goes into the manufacture of coke in Alabama is reported at the mines as shipped to market. The total quantity of coal made into coke in Alabama in 1903 was 4,237,491 short tons.

Distribution of the coal product of Alabama, 1889–1903.

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	87,843	135,627	2,233,767	5,529,312	5,788,898	1.05	271	10,075
1893	3,586,935	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	4,065,535	.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	10,783
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	78,908	244,223	2,760,298	10,354,570	12,419,666	1.20	256	16,439
1903	8,347,507	138,201	305,269	2,863,847	11,654,824	14,246,798	1.22	228	21,438

In the following table is shown the total production of Alabama since 1870:

Annual coal production of Alabama, 1870–1903.

Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*
1870 [a]	11,000	1887	1,950,000
1871	15,000	1888	2,900,000
1872	16,800	1889	3,572,983
1873	44,800	1890	4,090,409
1874	50,400	1891	4,759,781
1875	67,200	1892	5,529,312
1876	112,000	1893	5,136,935
1877	196,000	1894	4,397,178
1878	224,000	1895	5,693,775
1879	280,000	1896	5,748,697
1880 [a]	323,972	1897	5,893,770
1881	420,000	1898	6,535,283
1882	896,000	1899	7,593,416
1883	1,568,000	1900	8,394,275
1884	2,240,000	1901	9,099,052
1885	2,492,000	1902	10,354,570
1886	1,800,000	1903	11,654,324

[a] United States census fiscal year.

ALASKA.

The year 1903 has seen very little change in the development of the Alaskan coal fields. The production, which is limited entirely to that for local use, does not exceed a few thousand tons, but some of the coal-bearing areas give promise of being of considerable importance. In southeastern Alaska the Admiralty Island coal fields, which at one time promised to furnish lignites for local use, have been practically entirely abandoned. Three hundred miles to the westward, however, near Controller Bay, coal, which is not only of excellent quality, but which also occurs in veins of commercial importance, has been found on the Bering River. This coal resembles the harder bituminous coals of the East more than it does anthracite, but its composition shows it to be semianthracite of somewhat the same composition as the coals of the Bernice Basin in Pennsylvania, although it appears to be purer and has higher heating power than the latter.

Some prospecting of these seams has been made in a district which lies some 20 miles from the coast. At present there has been no production because it will be necessary to build a railroad to bring the coal to the coast. A detailed account of this field, by Dr. George C. Martin, has been published.[a]

Work was carried on for several years at Homer, on Kachemak Bay, in the Cook Inlet region of Alaska, but this was suspended in

[a] See Bull. U. S. Geol. Survey, No. 225, pp. 371–375.

1902 after three tunnels had been driven and two shafts had been sunk. This coal had found some local consumption, but work was suspended about the time the productive stage was reached.

Coal mining has been carried on in a limited way near Chignik Bay for several years, the product being used by the Alaska Packers' Association. The average production probably does not exceed 600 tons annually. Both the Chignik and Homer coal fields carry lignites of a fair quality, but the entire production up to date has probably not exceeded 5,000 tons.

The coal mining on the Yukon has received a decided check with the introduction of petroleum-burning engines on many of the river steamers. Practically all of the coal mining operations were suspended in this district during the summer of 1903, though some of the coal has been found to be of very good grade.[a] The production of the entire Yukon field probably has not exceeded 1,000 tons during 1903.

The demand for fuel on the part of the placer miners of the Seward Peninsula has led to a careful search for coal in this field, but with only moderate success. One small basin, however, has furnished probably 1,000 tons for local use. This area lies in the northeastern part of the peninsula, on Chicago Creek, a tributary of the Inmachuk River. Coal is said to find a ready market at this mine at $40 a ton.

Another possible source of fuel supply is to be found in the Cape Lisburne coal fields, lying about 300 miles north of Nome. Here coal is known to occur in considerable quantities, but it has been developed very little. In 1901 several cargoes were mined and sold at Nome for $18 and $20 a ton, in competition with Comax and Washington coal, at $25 a ton. The total amount produced in 1903 probably did not exceed 20 or 30 tons, and was disposed of to whalers. All of the mining was confined to the croppings along the sea cliff and was carried to ships in small boats.

ARKANSAS.

Total production in 1903, 2,229,172 short tons; spot value, $3,360,831.

Since 1899 the production of coal in Arkansas has increased annually, and in 1903, for the first time in the history of the State, the output exceeded 2,000,000 tons. Compared with 1902, the production in 1903 shows an increase of 285,240 short tons, or 14.7 per cent, in quantity and $821,617, or 32.4 per cent, in value. The average price in 1903 was $1.51 as compared with $1.31 in 1902. The price per ton in 1903 was the highest reached in the fifteen years for which the statistics are available.

A large part of the coal product of Arkansas is semianthracite in quality, highly prized as a domestic fuel in Memphis, St. Louis, and in other large cities in the Mississippi Valley, where it has largely sup-

[a] Collier, Arthur J., The coal resources of the Yukon: Bull. U. S. Geol. Survey No. 218.

planted the use of Pennsylvania anthracite. This coal is practically smokeless, burning with a short, hot flame, and leaves a comparatively small amount of ash. Of the total product in 1903, 1,344,996 short tons consisted of this semianthracite coal, as compared with 1,308,493 short tons of semianthracite produced in 1902.

During the year there were employed 4,157 men, who made an average of 223 days each, as compared with 3,595 men with an average of 188 days in 1902. The total number of tons mined for each man employed in 1903 was 536.2 as against 540.7 tons in 1902. The average tonnage per man per day decreased from 2.88 tons in 1902 to 2.4 tons in 1903, indicating a falling off of about 17 per cent in the daily efficiency of the mine workers. This is probably due to the decrease in the number of working hours per day, the mines being worked during 1903 on an average of eight hours per day.

In the following tables are presented the statistics of production in 1902 and 1903, with the distribution of the product for consumption, by counties, the average time worked, and the average number of employees:

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

Coal production of Arkansas in 1903, 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	387,234	2,153	5,497	394,884	$491,202	$1.24	227	650
Johnson	192,536	1,350	5,113	198,999	306,807	1.54	202	429
Logan	24,576	1,790	920	27,286	58,139	2.13	203	80
Pope	41,195	1,104	6,537	48,836	167,498	3.43	200	247
Sebastian	1,468,631	13,836	46,421	1,528,888	2,276,293	1.49	228	2,682
Ouachita, Perry, and Scott	28,816	175	1,288	30,279	60,892	2.01	196	69
Total	2,142,988	20,408	65,776	2,229,172	3,360,831	1.51	223	4,157

In the following table is shown the production since 1889, by counties:

Coal production of Arkansas, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.
Franklin	a257,196	a442,466	504,946	338,013	394,884
Johnson				193,258	198,999
Logan				21,751	27,286
Pope				34,966	48,836
Sebastian	580,358	999,479	1,305,190	1,825,181	1,528,888
Ouachita and Scott	....	....	....	30,763	b30,279
Small mines	6,000	6,000	6,000	(c)	....
Total	843,554	1,447,945	1,816,136	1,943,932	2,229,172

a Includes also production of Logan County.
b Includes also production of Perry County.
c Small-mine production included with county distribution.

Since 1889 the distribution of the coal product of Arkansas has been as follows:

Distribution of the coal product of Arkansas, 1889–1903.

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	631,968	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	903,998	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
1903	2,142,988	20,408	65,776	2,229,172	3,360,831	1.51	223	4,157

The Sixth United States Census, covering the fiscal year 1840, reported the coal production of Arkansas at 220 short tons, this being the first record of any coal production in that State. No other official figures of coal production were obtained until 1880 when for the fiscal year ending June 30 the output, according to the Tenth Census, amounted to 14,778 short tons. Since that date the production of

Arkansas has grown to large proportions, as is shown in the following table:

Annual production of coal in Arkansas, 1880–1903.

[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	1903	2,229,172

CALIFORNIA.

Total production in 1903, 104,673 short tons; spot value, $294,736.

Notwithstanding the increased production and use of petroleum in California, the output of coal in 1903 was larger than that of the preceding year. It did not, however, equal the production of any one of the four years immediately preceding 1902. As compared with 1902, the production of 1903 indicates an increase of 19,689 short tons, or 23 per cent in quantity, while the value increased $40,386, or 15.9 per cent. The larger part of the product continues to come from Alameda County, where the mines are conveniently located for supplying the market of San Francisco.

It is interesting to note that during 1903 a plant for briquetting lignite coal produced at Tesla, in Alameda County, was constructed, the object being to increase the fuel efficiency of the product by manufacturing it into briquettes, using heavy California crude petroleum as a binder.

The statistics of production in California since 1889 have been as follows:

Distribution of the coal product of California, 1889–1903.

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
1903	83,339	6,808	14,526	104,673	294,736	2.82	307	203

The records of the State Mining Bureau of California show a production of coal in that State as early as 1861. It was at that time one of the fifteen coal-producing States. During the latter part of that decade and of the one following, the production of California exceeded 100,000 tons annually, and reached a maximum of 237,000 tons in 1880. Since 1881 the production has been rather irregular, having been largely regulated by the imports of Australia and British Columbia coals. The receipts of Australian coal have depended principally upon the wheat production and shipments from the Pacific coast. Vessels bringing Australian coal as return cargoes have very low freight rates. During the last few years the production of oil in the State has also had considerable influence on the production of California coal. If the briquetting plant at Tesla proves to be a practical and commercial success, the industry should be less liable to the fluctuations to which it has been subjected in the past.

The table following shows the production of coal in California since 1861.

Coal production of California, 1861–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1861	6,620	1883	76,162
1862	23,400	1884	77,485
1863	43,200	1885	71,615
1864	50,700	1886	100,000
1865	60,530	1887	50,000
1866	84,020	1888	95,000
1867	124,690	1889	119,820
1868	143,676	1890	110,711
1869	157,234	1891	93,301
1870	141,890	1892	85,178
1871	152,493	1893	72,603
1872	190,859	1894	67,247
1873	186,611	1895	75,453
1874	215,352	1896	78,544
1875	166,638	1897	84,992
1876	128,049	1898	144,288
1877	107,789	1899	160,715
1878	134,237	1900	171,708
1879	147,879	1901	151,079
1880[a]	236,950	1902	84,984
1881	140,000	1903	104,673
1882	112,592		

[a] United States census, fiscal year.

COLORADO.

Total production in 1903, 7,423,602 short tons; spot value, $9,150,943.

Colorado ranks first among the coal-producing States west of the Mississippi River, and eighth among the entire United States. The development of coal mining in the State has been pushed with great energy during the last four or five years, and notwithstanding that conditions were very unsettled during 1903, as a result of strikes among the mine workers, the production was slightly in excess of that of the preceding year. It was considerably more than double that of 1897 and one and one-half times the output in 1899.

Comparing the production of the last two years, it is found that the output of 1903 was 22,259 short tons, or 0.3 per cent more than that of 1902, and that the value increased $753,131, or about 9 per cent.

A comparison of the statistics of 1903 as compared with those of 1902 shows that in the later year there was a decrease in the average production per man employed for the entire year and an increase in the average tonnage per man per day. In 1902 there were 8,956 men employed who worked an average of 261 days, producing 7,401,343 short tons, or 826 tons per man. In 1903 the number of employees was 9,229, working an average of 245 days, and producing 7,423,602 short tons, or an average of 804.4 tons per man for the year. The daily average production per man in 1902 was 3.16, while in 1903 it increased to 3.28, showing a greater intensity of labor during the time the mines were in operation. The time lost by strike is illustrated in the decrease from an average of 261 working days in 1902 to 245 working days in 1903. The average number of working hours per day in 1903 was 9.

The production, by counties, in 1902 and 1903, with the distribution of the product for consumption, and the statistics of labor employed, is shown in the following tables:

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.

Coal production of Colorado in 1903, 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	721,986	38,183	43,755	....	803,924	$1,202,867	$1.50	184	1,221
Delta	4,960	8,009	60	....	13,029	19,510	1.50	217	49
El Paso	127,579	78,336	1,882	....	207,797	267,893	1.29	234	307
Fremont	581,967	23,453	28,438	....	633,858	1,110,373	1.75	257	881
Garfield	167,299	4,498	4,557	....	176,354	208,926	1.18	161	278
Gunnison	330,781	2,600	7,304	95,919	436,604	626,359	1.43	263	565
Huerfano	1,283,594	6,496	29,576	....	1,319,666	1,757,722	1.34	267	1,549
La Plata	136,682	6,161	794	....	143,637	214,431	1.49	229	202
Las Animas	2,009,868	37,491	59,586	1,106,798	3,213,743	3,191,565	.99	264	3,664
Mesa	27,680	752	20	....	28,452	42,628	1.50	169	57
Routt	....	2,775	....	....	2,775	4,175	1.50	117	14
Weld	61,747	28,325	4,420	....	94,492	146,544	1.55	202	192
Other counties[a]	164,690	3,736	8,173	170,175	346,774	353,495	1.02	233	250
Small mines	....	2,497	....	....	2,497	4,455	......	....	....
Total	5,618,833	243,312	188,565	1,372,892	7,423,602	9,150,943	1.23	245	9,229

[a] Arapahoe, Larimer, Pitkin, and Rio Blanco.

As is shown in the following table, there were no very decided increases or decreases in any of the coal-producing counties. The more important increases were in Gunnison County, from 364,874 short tons in 1902 to 436,604 short tons in 1903, and Huerfano County, which increased from 1,189,313 short tons in 1902 to 1,319,666 short tons in 1903. The counties in which the larger decreases in production occurred are Fremont, which dropped from 695,999 short tons in 1902 to 633,858 short tons in 1903; Garfield, from 207,262 short tons in 1902 to 176,354 short tons in 1903; and Pitkin, which decreased from 414,244 short tons in 1902 to 342,054 short tons in 1903.

The production of the State, by counties, since 1899, with the increases and decreases of 1903 as compared with 1902, is shown in the following table:

Coal production of Colorado, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Boulder	540,475	574,334	482,975	806,371	803,924	....	2,447
Delta	....	....	....	9,350	13,029	3,679	....
El Paso	....	94,334	175,979	218,549	207,797	....	10,752
Fremont	620,609	619,413	536,313	695,999	633,858	....	62,141
Garfield	134,354	141,159	173,707	207,262	176,354	....	30,908
Gunnison	319,434	432,555	397,043	364,874	436,604	71,730	....
Huerfano	632,577	854,944	918,609	1,189,313	1,319,666	130,353	....
Jefferson	9,900	3,000	....	....	....	....	....
La Plata	116,500	123,524	144,892	155,029	143,637	....	11,392
Las Animas	2,125,143	2,123,411	2,476,138	3,245,271	3,213,743	....	31,528
Pitkin	172,917	175,942	325,872	414,244	342,054	....	72,190
Routt	....	....	1,558	3,180	2,775	....	405
Weld	47,573	80,015	33,374	73,681	94,492	20,811	....
Other counties	56,742	21,733	33,555	18,220	35,669	17,449	....
Total	4,776,224	5,244,364	5,700,015	7,401,343	7,423,602	a 22,259	....

a Net increase.

The distribution of the coal product of Colorado from 1889 to 1903 is shown in the following table:

Distribution of the coal product of Colorado, 1889–1903.

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

Distribution of the coal product of Colorado, 1889–1903—Continued.

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.*				
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
1903	5,618,833	243,312	188,565	1,372,892	7,423,602	9,150,943	1.23	245	9,229

Colorado is one of the few States from which we have a reliable record of its coal production from the time coal was first produced in the State. The records show that Colorado began producing coal in 1864, in which year the output amounted to only 500 tons. It was not until 1876 that the production reached 100,000 tons. From that time it has increased with remarkable rapidity, reaching a total of 1,000,000 short tons in 1882, and of 2,000,000 tons in 1888. The 3,000,000-ton mark was reached in 1890, 4,000,000 in 1893, and 5,000,000 in 1900. The following table shows the annual production from the time that coal mining began in 1864 to the close of 1903:

Coal production of Colorado, 1864–1903.

[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 [a]	4,500	1890	3,077,003
1871	15,600	1891	3,512,632
1872	68,540	1892	3,510,830
1873	69,997	1893	4,102,389
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 [a]	462,747	1900	5,244,364
1881	706,744	1901	5,700,015
1882	1,061,479	1902	7,401,343
1883	1,229,593	1903	7,423,602

[a] United States census, fiscal year.

GEORGIA.

Total production in 1903, 416,951 short tons; spot value, $521,459.

The entire coal production of Georgia comes from two counties in the northwestern part of the State—Dade and Walker. The coal beds form a part of what is known as the Warrior field of the adjoining State of Alabama. Although on the extreme eastern limit of the basin the coal mined in Georgia is of excellent quality and enjoys an enviable reputation as a steam-raising fuel. It is in good demand for bunker coal at South Atlantic ports. It is also well adapted for the manufacture of coke, which finds a market among the iron furnaces in the vicinity of Chattanooga.

The coal production of the State has increased steadily since 1899. The production of 1903, compared with 1902, shows an increase of 2,868 short tons, while the value decreased $67,559. The average price per ton for all coal sold in the State decreased from $1.42 to $1.25.

Owing to the fact that a large number of the mine workers of Georgia are convicts leased from the State the statistics of labor employed are of comparatively little value. It is interesting to note, however, that the mines of that State are operated an average of ten hours per day, while in most of the other States the average is eight or nine.

The statistics of production during the last fifteen 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	308	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
1903	267,369	812	2,218	146,552	416,951	521,459	1.25	298	681

The United States census for 1860 credited Georgia with an output of 1,900 short tons of coal. From that date until 1884 whatever production there may have been, was not reported.

With the opening of the mines in Walker County in 1884 the production was estimated at 150,000 tons. Since that date the output of the State has been as follows:

Coal production of Georgia, 1884–1903.

[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	1903	416,951

ILLINOIS.

Total production in 1903, 36,957,104 short tons; spot value, $43,-196,809.

Compared with the production in 1902 the output of Illinois in 1903 shows an increase of 4,017,731 short tons, or 12.2 per cent, in quantity, and of $9,250,899, or 27.3 per cent, in value. The increase in value in 1903 over 1902 surpasses all previous records made in the State. The increased value of 1902 over 1901 ($5,781,973) makes a total increase for the two years of $15,032,872, or more than 53 per cent of the total value in 1901. The production in the two years shows an increase of 9,625,552 short tons, or 35 per cent.

Illinois continues to hold second place among the coal-producing States, and by the increases of the last two years has considerably outstripped her only rival, West Virginia. One of the causes of this increased production in Illinois is the comparative immunity from strikes in the coal mines since 1898. The production of West Virginia, on the other hand, was considerably interfered with by labor troubles during 1902 and 1903. Another interesting feature in connection with the production of coal in Illinois was the increase in the average production per man for the year as compared with the two preceding years. In 1901 the average production per man was 653 short tons, in 1902 it was 695 short tons, and in 1903 it was 731 short tons. The average production per man per day has increased from 2.97 short tons in 1901 and 3.08 tons in 1902 to 3.21 tons it 1903. Part of this increased efficiency, if not all, was due to the increased use of mining machinery.

The report for 1901 showed there were 464 machines in use in the State in 1901 that produced 5,774,639 tons of coal. In 1902 the number of machines reported in use was 508 and the total machine product was 7,112,039 tons. In 1903 the machine-mined product was 7,381,027 tons, and the number of machines reported in use was 553.

The mine workers in Illinois averaged eight hours per day during 1903.

In the following tables are shown the statistics of production, by counties, in 1902 and 1903, the distribution of the production for consumption, and the statistics of labor employed:

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	248	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	988
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	25
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	1,286
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	406
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	862
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	596
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	1,830
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

Coal production of Illinois 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.*				
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.

Coal production of Illinois in 1903, 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.*				
Bureau	1,712,289	62,315	72,038	....	1,846,642	$2,827,138	$1.53	267	4,116
Christian	929,600	53,796	40,996	....	1,024,392	1,307,828	1.28	174	1,449
Clinton	814,650	61,772	43,969	....	920,391	972,424	1.06	251	1,008
Fulton	1,011,004	61,015	33,911	....	1,105,930	1,425,714	1.29	236	1,715
Gallatin	39,048	26,481	2,000	4,676	72,205	78,735	1.09	217	116
Grundy	1,271,817	59,726	60,884	....	1,392,427	2,006,178	1.44	243	3,100
Hancock	3,030	4,350	....	....	7,380	12,639	1.71	175	24
Henry	86,039	66,634	4,197	....	156,870	267,735	1.71	215	316
Jackson	824,869	28,928	59,486	....	913,283	1,181,441	1.29	210	1,168
Johnson	....	2,233	100	....	2,333	2,770	1.19	128	12
Knox	49,007	52,966	3,082	....	105,055	156,545	1.49	195	230
Lasalle	1,487,179	315,640	56,310	23,460	1,882,589	2,893,136	1.54	267	3,563
Livingston	83,933	35,482	3,358	....	122,773	211,983	1.73	81	651
Logan	404,398	48,740	16,440	....	469,578	471,758	1.00	251	583
McDonough	16,442	11,450	212	....	28,104	50,297	1.79	190	125
McLean	104,265	80,735	13,100	....	198,100	320,650	1.62	276	433
Macoupin	2,229,211	80,547	104,741	....	2,414,499	2,536,826	1.05	203	2,856
Madison	2,765,777	75,972	108,747	....	2,950,496	2,730,861	.93	235	2,970
Marion	935,470	120,232	40,250	....	1,095,952	1,087,686	.99	258	1,204
Marshall	436,291	19,166	24,184	....	479,641	721,297	1.50	269	949
Menard	423,648	36,550	23,249	....	483,447	579,050	1.20	197	675
Mercer	591,680	31,281	19,785	....	642,746	905,379	1.41	249	886
Montgomery	402,078	46,587	10,322	....	458,987	480,561	1.05	188	609
Peoria	788,203	153,636	17,143	....	958,982	1,251,105	1.30	227	1,316
Perry	1,181,250	26,538	28,580	....	1,236,368	1,301,601	1.05	223	1,662
Randolph	496,466	26,318	13,111	....	535,895	389,703	.73	143	897
Rock Island	28,290	39,011	2,340	....	69,641	109,018	1.57	177	155
St. Clair	3,127,471	224,098	112,500	....	3,464,069	3,300,666	.95	232	3,231
Saline	401,304	15,833	16,191	....	433,328	435,831	1.01	198	487

Coal production of Illinois in 1903, 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.*				
Sangamon	4,035,201	302,823	132,938	....	4,470,962	$4,787,749	$1.07	216	5,327
Schuyler	5,600	7,277	50	....	12,927	19,447	1.50	208	30
Scott	13,150	11,271	355	....	24,776	38,835	1.57	255	55
Shelby	67,061	36,218	5,229	....	108,508	162,074	1.49	179	222
Stark	22,000	20,366	800	....	43,166	64,022	1.48	203	101
Tazewell	172,157	75,609	5,887	....	253,653	325,104	1.28	208	316
Vermilion	2,699,064	206,919	49,088	....	2,955,071	3,743,467	1.27	249	3,410
Warren	....	14,939	50	....	14,989	27,722	1.85	183	38
Washington	72,369	16,697	2,700	....	91,766	97,259	1.06	213	120
Will	34,924	11,889	2,427	....	49,240	79,749	1.62	212	146
Williamson	2,774,405	26,990	80,258	....	2,881,653	3,042,401	1.06	203	3,325
Other counties[a]	370,651	139,732	21,196	....	531,579	716,234	1.35	236	1,000
Small mines	....	46,711	....	....	46,711	76,241	......	....	....
Total	32,911,291	2,785,473	1,232,204	28,136	36,957,104	43,196,809	1.17	228	50,506

[a] Bond, Calhoun, Cass, Greene, Hamilton, Jefferson, Kankakee, Macon, Morgan, Wabash, and Woodford.

There were 51 counties in Illinois which produced coal in 1903. Of this number there were 37 in which the production exceeded that of 1903, and 14 whose output shows a decrease. The most important gains were made by St. Clair, Madison, and Williamson counties, in all of which the production increased more than half a million tons in 1903. The greatest loss was sustained by Livingston County, whose production fell off 272,310 tons, or about 70 per cent. In the following table is shown the production of Illinois during the last five years, by counties, with the increases and decreases in 1903 as compared with 1902:

Coal production of Illinois in 1899, 1900, 1901, 1902, and 1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Bond	100,955	150,000	151,750	100,000	176,342	76,342	....
Brown	2,630	....	....	1,230	....	....	1,230
Bureau	1,400,908	1,318,784	1,594,803	1,769,642	1,846,642	77,000	....
Calhoun	6,113	6,300	5,923	3,000	5,300	2,300	....
Cass	3,430	....	....	....	1,768	1,768	....
Christian	617,027	622,183	616,373	936,036	1,024,392	88,356	....
Clinton	577,454	531,457	765,060	834,318	920,391	86,073	....
Fulton	651,694	602,645	654,416	953,607	1,105,930	152,323	....
Gallatin	16,836	5,969	4,800	30,911	72,205	41,294	....
Greene	15,420	5,220	3,808	6,000	6,639	639	....
Grundy	1,257,092	1,315,688	1,269,741	1,414,479	1,392,427	....	22,052
Hamilton	640	....	....	....	1,200	1,200	....

Coal production of Illinois in 1899, 1900, 1901, 1902, and 1903, by counties—Continued.

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Hancock	5,498	1,267	6,106	13,400	7,380	....	6,020
Henry	92,429	72,046	89,465	138,312	156,870	18,558	....
Jackson	808,340	985,998	870,093	930,487	913,283	....	17,204
Jefferson	63,010	48,648	50,000	25,090	28,245	3,155	....
Jersey	4,050	....	....	3,520	....	....	3,520
Johnson	3,541	1,760	1,010	3,850	2,333	....	1,517
Kankakee	129,262	109,129	67,195	48,439	74,226	25,787	....
Knox	55,924	62,423	78,636	85,851	105,055	19,204	....
Lasalle	2,015,304	2,022,462	1,751,758	1,846,236	1,882,589	36,353	....
Livingston	129,484	236,872	307,267	395,083	122,773	....	272,310
Logan	185,480	156,901	161,611	268,707	469,578	200,871	....
McDonough	42,269	30,293	31,337	34,636	28,104	....	6,532
McLean	186,487	207,304	144,959	175,000	198,100	23,100	....
Macon	150,403	58,025	86,468	100,000	110,000	10,000	....
Macoupin	1,727,102	2,012,540	1,960,038	2,185,325	2,414,499	229,174	....
Madison	1,538,049	1,510,394	1,911,381	2,374,684	2,950,496	575,812	....
Marion	710,487	805,859	844,816	922,656	1,095,952	173,296	....
Marshall	350,732	396,087	417,444	458,186	479,641	21,455	....
Menard	432,948	397,077	390,931	471,958	483,447	11,489	....
Mercer	503,474	564,247	563,350	640,141	642,746	2,605	....
Montgomery	301,424	304,200	367,326	619,448	458,987	....	160,461
Morgan	4,506	4,500	3,000	4,780	4,358	....	422
Peoria	792,239	717,939	659,701	852,375	958,982	106,607	....
Perry	809,425	561,091	632,089	991,344	1,236,368	245,024	....
Randolph	437,084	466,547	368,951	456,984	535,895	78,911	....
Rock Island	44,005	44,078	68,356	83,418	69,641	....	13,777
St. Clair	2,079,853	2,232,786	2,298,843	2,822,248	3,464,069	641,821	....
Saline	95,736	116,650	163,584	297,571	433,328	135,757	....
Sangamon	2,289,708	2,738,402	3,277,939	4,172,722	4,470,962	298,240	....
Schuyler	15,874	4,992	5,552	18,457	12,927	....	5,530
Scott	22,227	27,097	23,680	27,435	24,776	....	2,659
Shelby	105,409	109,392	114,192	87,112	108,508	21,396	....
Stark	25,430	15,191	13,400	29,043	43,166	14,123	....
Tazewell	98,092	92,843	145,569	173,018	253,653	80,635	....
Vermilion	2,191,067	2,189,474	2,260,964	2,585,291	2,955,071	369,780	....
Warren	16,992	12,019	10,300	16,077	14,989	....	1,088
Washington	32,360	37,291	25,700	56,835	91,766	34,931	....
Will	42,275	55,323	56,646	40,792	49,240	8,448	....
Williamson	1,072,367	1,508,453	1,743,052	2,325,942	2,881,653	555,711	....
Woodford	179,024	192,135	142,219	101,567	[a] 123,501	21,934	....
Small mines	....	150,000	150,000	6,130	46,711	40,581	....
Total	24,439,019	25,767,981	27,331,552	32,939,373	36,957,104	[b] 4,017,731	....

[a] Includes production of Wabash County. [b] Net increase.

Since 1889 the distribution of the coal production of Illinois has been as shown in the following table:

Distribution of the coal product of Illinois, 1889–1903.

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	225	39,101
1901..........	24,295,861	2,156,344	879,347	....	27,331,552	28,163,987	1.03	220	41,880
1902..........	29,299,187	2,591,770	1,048,381	85	32,939,373	33,945,910	1.03	226	47,411
1903..........	32,911,291	2,785,473	1,232,204	28,136	36,957,104	43,196,809	1.17	228	50,596

R. C. Taylor, in his well-known work Statistics of Coal, published in 1848, 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 illustrated his journal. He points out a 'cole mine' about Fort Creve-cœur on the Illinois River, near to the site of the present Ottawa."

This is probably the first mention made of the occurrence of coal in the United States, and outside of anthracite mining in Pennsylvania and the records of the Richmond basin in Virginia the earliest statistics are contained in the records of Illinois production. The earliest statement that we have is that coal was mined in Jackson County in 1810 from a point on the Big Muddy River. A flatboat was loaded with coal at this place and shipped to New Orleans, but the amount was not stated. Again, it is reported that in 1832 several boat loads were sent from the same vicinity to the same market. Another record is found stating that 150,000 bushels (or 6,000 tons) of coal were mined in 1833 in St. Clair County and hauled by wagons to St. Louis. From 1840 to 1860 the Bureau of Statistics of the State is without any reliable data in regard to the coal-mining industry, although some scattering statistics are found in the geologic reports published by the State government.

The following table shows the statistics of coal production in Illinois from 1833 to 1903, inclusive, and for the years for which there is no special information the production has been estimated by the writer:

Coal production of Illinois, 1833–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1833	6,000	1869	1,854,000
1834	7,500	1870	2,624,163
1835	8,000	1871	3,000,000
1836	10,000	1872	3,360,000
1837	12,500	1873	3,920,000
1838	14,000	1874	4,203,000
1839	15,038	1875	4,453,178
1840	16,967	1876	5,000,000
1841	35,000	1877	5,350,000
1842	58,000	1878	5,700,000
1843	75,000	1879	5,000,000
1844	120,000	1880	6,115,377
1845	150,000	1881	6,720,000
1846	165,000	1882	9,115,653
1847	180,000	1883	12,123,456
1848	200,000	1884	12,208,075
1849	260,000	1885	11,834,459
1850	300,000	1886	11,175,241
1851	320,000	1887	12,423,066
1852	340,000	1888	14,328,181
1853	375,000	1889	12,104,272
1854	385,000	1890	15,292,420
1855	400,000	1891	15,660,698
1856	410,000	1892	17,862,276
1857	450,000	1893	19,949,564
1858	490,000	1894	17,113,576
1859	530,000	1895	17,735,864
1860 [a]	728,400	1896	19,786,626
1861	670,000	1897	20,072,758
1862	780,000	1898	18,599,299
1863	890,000	1899	24,439,019
1864	1,000,000	1900	25,767,981
1865	1,260,000	1901	27,331,552
1866	1,580,000	1902	32,939,373
1867	1,800,000	1903	36,957,104
1868	2,000,000		

[a] United States census, fiscal year.

From this record it appears that the total production of the State from 1833 to the close of 1903 has amounted to over 475,000,000 tons.

INDIANA.

Total production in 1903, 10,794,692 short tons; spot value, $13,-244,817.

Indiana's coal production for the first time in the history of the State exceeded a total of 10,000,000 tons. The year 1903 is the seventh in succession in which the production has increased and in which the output has exceeded previous records. In addition to the increase in production of 1,348,268 short tons, or 14.3 per cent in quantity, the value of the output showed a gain of $2,845,157, or 27.4 per cent, the percentage of increase in value being a little more than half as much again as the percentage of increase of production. The average price per ton advanced from $1.10 in 1902 to $1.23 in 1903, which is the highest point reached since figures of quantity and value of the output of coal mines of the State have been collected.

The statistics of labor employed in the coal mines of the State show that in 1903 there were 17,017 men employed, as compared with 15,457 in 1902 and 12,968 in 1901. In 1901 there were 533.5 tons produced for each man employed, and in 1902 there were 611.1 tons produced for each man. In the former year the average working time was 194 days, and in 1902 it was 205 days. In 1903 17,017 men worked an average of eight hours a day for 197 days, producing an average of 634.3 tons per man. In 1901 the average tonnage per man per day was 2.75; in 1902 it increased to 2.98, and in 1903 to 3.22. It is interesting to note in connection with this statement the increased use of undercutting machines in the coal mines of the State, and this is probably responsible in large part for the increased production per man per day. The number of coal-mining machines in use has increased from 256 in 1901 to 269 in 1902 and to 329 in 1903. The amount of machine-mined coal in 1901 was 1,852,058 tons, which increased to 2,421,342 tons in 1902, and to 3,334,961 tons in 1903. The increase in the production by the use of machines was about 10 per cent more than the total increase in the State.

The statistics of production by counties in 1902 and 1903, with the distribution of the product for consumption, are presented in the tables following.

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	180	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

Coal production of Indiana in 1903, 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	1,139,166	43,911	59,881	....	1,242,958	$1,884,955	$1.52	206	2,567
Daviess	163,191	18,293	2,208	....	183,692	261,551	1.42	231	390
Dubois and Martin	3,000	5,358	188	....	8,546	12,310	1.44	209	23
Fountain	15,460	3,200	....	....	18,660	23,660	1.27	179	50
Gibson	63,497	13,424	5,025	....	81,946	108,526	1.32	151	198
Greene	2,215,847	43,416	44,249	....	2,303,512	2,889,415	1.25	188	3,103
Knox	135,127	33,259	8,660	....	177,046	239,813	1.35	152	335
Parke	913,032	29,691	47,260	....	989,983	1,368,847	1.38	209	1,819
Perry	14,783	9,686	472	....	24,941	37,488	1.50	231	67
Pike	462,775	28,601	10,933	3,255	505,564	590,790	1.17	173	1,017
Spencer	4,349	15,519	80	....	19,948	22,659	1.14	150	74
Sullivan	1,700,205	39,118	49,005	....	1,788,358	2,031,358	1.14	198	2,411
Vanderburg	74,368	158,259	8,461	....	241,088	295,989	1.23	254	346
Vermilion	889,009	4,592	21,570	....	915,171	961,088	1.05	181	1,308
Vigo	1,673,478	95,819	57,096	....	1,826,393	2,023,540	1.11	201	2,717
Warren	....	5,250	....	....	5,250	11,375	2.17	222	14
Warrick	360,087	66,660	9,050	....	435,797	447,846	1.03	201	583
Small mines	....	25,839	....	....	25,839	33,607	.....	......	....
Total	9,827,374	639,925	324,138	3,255	10,794,692	13,244,817	1.23	197	17,017

Excluding from consideration the production of the small mines of the State, there were eleven counties in which the product increased in 1903, as compared with the preceding year and six in which the output was less. The most important increases were those make by Greene County, 639,727 tons; Sullivan County, 519,413 tons; Vermilion County, 197,069 tons, and Vigo County, 173,595 tons. The development in Greene County within the last five years has been particularly noticeable. In 1898 this county produced only 526,800 tons, considerably less than the amount of increase of 1903 as compared with 1902. The production of this county in 1903 was considerably more than four times what it was in 1898. Sullivan County developments have been scarcely less noticeable. This county in 1898 produced less than 640,000 tons, and in 1903 it produced 1,788,358 tons, or nearly three times the output of 1898.

The most important decreases in 1903 were observed in the output of Parke County, which decreased 165,474 tons, and Daviess County, 51,291 tons.

In the following table is presented a statement of the production by counties during the last five years and the increases and decreases in 1903 as compared with 1902:

Coal production of Indiana, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Clay	1,253,948	1,165,302	1,080,164	1,315,046	1,242,958		72,088
Daviess	a 266,029	a 276,625	a 238,699	234,983	183,692		51,291
Dubois				10,094	a 8,546		1,548
Fountain	55,750	44,232	34,826	17,099	18,660	1,561	
Gibson	75,420	66,889	116,526	105,468	81,946		23,522
Greene	681,799	723,255	944,621	1,663,785	2,303,512	639,727	
Knox	49,684	60,749	94,579	119,225	177,046	57,821	
Owen							
Parke	638,181	649,665	631,032	1,155,457	989,983		165,474
Perry	28,700	24,077	16,822	21,577	24,941	3,364	
Pike	191,589	245,433	269,268	510,017	505,564		4,453
Spencer	13,946	9,106	18,885	16,274	19,948	3,674	
Sullivan	752,734	939,989	910,725	1,268,945	1,788,358	519,413	
Vanderburg	152,430	192,582	193,716	218,112	241,088	22,976	
Vermilion	609,876	649,525	684,253	718,102	915,171	197,069	
Vigo	1,029,699	1,151,543	1,362,041	1,652,798	1,826,393	173,595	
Warren				3,380	5,250	1,870	
Warrick	170,738	249,064	286,068	416,062	435,797	19,735	
Small mines	36,000	36,000	36,000	(a)	25,839	25,839	
Total	6,006,523	6,484,086	6,918,225	9,446,424	10,794,692	b 1,348,268	

a Includes Martin County. b Net increase.

The distribution of the product for consumption during the last fifteen years is shown in the following table:

Distribution of the coal product of Indiana, 1889–1903.

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
1903	9,827,374	639,925	324,138	3,255	10,794,692	13,244,817	1.23	197	17,017

It is probable that coal mining in Indiana really began about the same time it did in Illinois (1833), but the earliest record for the State is that contained in the census report for 1840, which credits Indiana with a production of 9,682 short tons. Between that date and 1870, or for a period of thirty years, no official statistics were obtained. The census report for 1870 shows a total production in that year of 437,870 tons. Since 1870 the annual production of Indiana has been as shown in the following table:

Production of coal in Indiana, 1870–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1870 a	437,870	1887	3,217,711
1871	600,000	1888	3,140,979
1872	896,000	1889	2,845,057
1873	1,000,000	1890	3,305,737
1874	812,000	1891	2,973,474
1875	800,000	1892	3,345,174
1876	950,000	1893	3,791,851
1877	1,000,000	1894	3,423,921
1878	1,000,000	1895	3,995,892
1879	1,196,490	1896	3,905,779
1880 a	1,454,327	1897	4,151,169
1881	1,984,120	1898	4,920,743
1882	1,976,470	1899	6,006,523
1883	2,560,000	1900	6,484,086
1884	2,260,000	1901	6,918,225
1885	2,375,000	1902	9,446,424
1886	3,000,000	1903	10,794,692

a United States census, fiscal year.

INDIAN TERRITORY.

Total production in 1903, 3,517,388 short tons; spot value, $6,386,463.

The coal production in Indian Territory has increased steadily each year since 1897, and reached a total exceeding 3,000,000 tons for the first time in 1903. Compared with 1902, the output of last year showed an increase of 696,722 short tons, or 24.7 per cent in quantity, and of $2,121,357, or 49.7 per cent in value. The average price per ton obtained in 1903, $1.82, was, as was the case with a number of States, the highest on record. At the same price obtained in 1903 as in 1902, the total value of the coal production of last year would be $5,311,256, so that there was an actual gain in value, outside of the increased production, of $1,075,207. The output in 1903 was two and one-third times what it was in 1899, while the value was three times as great.

In 1903 the total number of men employed in the coal mines of Indian Territory was 7,704, as compared with 5,574 in 1902 and with 6,706 in 1901. The average working time made by the mine workers in 1903 was 247 days, 232 days in 1902, and 208 days in 1901. The average production per man in 1903 was 457 short tons, as compared with 506 tons in 1902 and with 361 tons in 1901. The average tonnage per man per day was 1.85 in 1903, as compared with 2.18 in 1902 and with 1.74 in 1901.

The following table shows the production of coal in Indian Territory, with the distribution of the product for consumption, and the statistics of labor employed for the last thirteen years:

Distribution of the coal product of Indian Territory, 1891-1903.

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	1,444,068	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
1903	3,329,610	32,610	78,995	76,178	3,517,388	6,386,463	1.82	247	7,704

The first production of coal reported in Indian Territory was in 1880. Since that date the annual output, so far as has been ascertained, has been as follows:

Production of coal in Indian Territory, 1880, 1885–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1880[a]	120,947	1894	969,606
1885	500,000	1895	1,211,185
1886	534,580	1896	1,366,646
1887	685,911	1897	1,336,380
1888	761,986	1898	1,381,466
1889	752,832	1899	1,537,427
1890	869,229	1900	1,922,298
1891	1,091,032	1901	2,421,781
1892	1,192,721	1902	2,820,666
1893	1,252,110	1903	3,517,388

[a] United States census, fiscal year.

IOWA.

Total production in 1903, 6,419,811 short tons; spot value, $10,563,910.

Compared with 1902 the coal production of Iowa in 1903 shows an increase of 515,045 short tons, or 8.7 per cent, in quantity and $1,903,623, or 22 per cent, in value. Iowa shared with the majority of the coal-producing States in a decided advance in price of coal during 1903, due to shortage in fuel caused by the anthracite strike in Pennsylvania the previous year, and which resulted in an additional demand from producers of bituminous coal. The effect of these conditions was felt as far West as Iowa, Kansas, and Missouri, and the other coal fields of the Mississippi Valley. The average price of coal in Iowa in 1903 was $1.65, the highest figure yet recorded.

During 1903 there were employed in the Iowa coal mines 14,162 men who worked an average of 226 days of eight hours each, as compared with 12,434 men for 227 days in 1902, and with 12,653 men for 218 days in 1901. The average production per man per year in 1903 was 453.3, as compared with 475 in 1902, and with 444 in 1901. The production per man per day increased from 2.04 in 1901 to 2.09 in 1902, but fell off to 2 tons in 1903. The statistics of the use of mining machines show that 55,085 tons, or 0.86 per cent of the total production in 1903, was obtained by the use of mining machines, as compared with 110,489 tons in 1902.

The statistics of production and of labor employed at the Iowa coal mines in 1902 and 1903, with the distribution of the product for consumption, are shown in the following tables.

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

Coal production of Iowa in 1903, 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		22,550	20	22,570	$55,540	$2.46	168	82
Appanoose	855,033	31,024	6,964	893,021	1,799,319	2.01	186	2,984
Boone	259,431	25,785	6,105	291,321	595,004	2.04	215	798
Dallas	6,436	8,131	900	15,467	36,424	2.35	114	70
Greene		14,121	850	14,971	32,880	2.20	163	56
Guthrie		14,008	25	14,033	38,428	2.74	179	84
Jasper	203,346	58,708	8,750	270,804	430,843	1.59	280	621
Jefferson	1,300	5,218	326	6,844	15,277	2.23	164	27
Keokuk	50,138	9,884	2,853	62,875	81,526	1.30	166	168
Mahaska	574,942	99,295	23,929	698,166	1,039,190	1.49	223	1,455
Marion	289,391	28,529	6,939	324,859	397,964	1.22	204	691
Monroe	1,686,616	44,203	37,235	1,768,054	2,558,683	1.45	261	2,968
Polk	726,774	269,520	35,870	1,032,164	1,788,609	1.73	235	1,973
Scott		12,274	379	12,653	24,548	1.94	174	54
Taylor	8,981	7,932	20	16,933	30,858	1.82	216	78
Van Buren	9,348	4,173	40	13,561	25,925	1.91	213	38

Coal production of Iowa in 1903, by counties—Continued.

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.*				
Wapello	293,522	83,674	5,202	382,398	$593,598	$1.55	242	743
Warren	8,360	4,400	....	12,760	27,366	2.14	149	37
Wayne	92,968	11,961	241	105,170	203,671	1.94	209	308
Webster	117,720	14,961	5,615	138,296	281,492	2.03	211	357
Davis, Lucas, and Page	194,945	109,560	10,552	315,057	490,970	1.56	275	570
Small mines	....	7,834	....	7,834	15,795	......	......	......
Total	5,379,251	887,745	152,815	6,419,811	10,563,910	1.65	226	14,162

Ignoring the production of the small county banks, the total output of which in 1903 was less than 20,000 tons, there were thirteen counties in which the production increased and nine in which the output was less than that of the preceding year. The most important increase is by Monroe County, which since 1901 has held first rank among the coal-producing counties of the State. This county in 1903 showed a gain of 361,149 tons over the preceding year. In 1899 Monroe was the third producing county in the State, and the output was a little more than half of that of Mahaska County, which ranked first. In 1903 Monroe County produced nearly three times as much as Mahaska County. The increases and decreases in the other counties in 1903 are of comparatively little importance, as is shown in the following table:

Coal production of Iowa, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Adams	....	....	....	19,751	22,570	2,819	....
Appanoose	636,421	680,094	721,997	900,337	893,021	....	7,316
Boone	290,525	266,542	254,054	254,324	291,321	36,997	....
Dallas	10,804	16,737	16,987	18,845	15,467	....	3,378
Davis	....	....	....	3,953	3,160	....	793
Greene	17,568	17,044	18,810	11,573	14,971	3,398	....
Jasper	191,928	99,948	184,670	233,440	270,804	37,364	....
Jefferson	....	....	....	10,610	6,844	....	3,766
Keokuk	314,900	258,933	308,193	106,103	62,875	....	43,228
Lucas	32,419	227,921	221,058	246,400	295,554	49,154	....
Mahaska	1,273,473	1,142,017	929,110	723,567	698,166	....	25,401
Marion	231,668	186,446	145,981	315,425	324,859	9,434	....
Monroe	689,004	755,286	1,038,332	1,406,905	1,768,054	361,149	....
Page	....	....	....	10,070	16,348	6,278	....
Polk	749,708	827,482	1,025,014	1,023,860	1,032,164	8,304	....
Scott	....	....	....	10,358	12,653	2,295	....
Taylor	10,965	17,159	23,499	14,207	16,933	2,726	....
Van Buren	9,385	12,108	12,572	14,816	13,561	....	1,255

Coal production of Iowa, 1899-1903, by counties—Continued.

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Wapello	325,029	276,360	312,174	340,762	382,398	41,636	....
Warren	34,815	24,724	14,661	20,127	12,760	....	7,367
Wayne	62,818	65,140	56,578	65,374	105,170	39,796	....
Webster	124,841	123,660	146,020	149,615	138,296	....	11,319
Other counties and small mines	171,208	205,338	187,789	4,344	21,867	17,523	....
Total	5,177,479	5,202,939	5,617,499	5,904,766	6,419,811	a 515,045	....

a Net increase.

The distribution of the product for consumption since 1889 is shown in the following table:

Distribution of the coal product of Iowa, 1889-1903.

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	3,580,373	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
1903	5,379,251	887,745	152,815	....	6,419,811	10,563,910	1.65	226	14,162

The United States census of 1840 showed that Iowa produced in that year a total of 400 tons, and Missouri, the adjoining State south, a total of 9,972 tons in the same year. This is the first record we have of any coal production west of the Mississippi River. From 1840 to 1860 and from 1861 to 1865 the records of production in Iowa are very unreliable. From the best information obtainable the production for these missing years has been estimated in the following table. From 1865 to the close of 1903 the statistics of production have been obtained with a considerable degree of accuracy.

Production of coal in Iowa, 1860–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1860 a	41,920	1882	3,920,000
1861	50,000	1883	4,457,540
1862	53,000	1884	4,370,566
1863	57,000	1885	4,012,575
1864	63,000	1886	4,315,779
1865	69,574	1887	4,473,828
1866	99,320	1888	4,952,440
1867	150,000	1889	4,095,358
1868	241,453	1890	4,021,739
1869	295,105	1891	3,825,495
1870 a	263,487	1892	3,918,491
1871	300,000	1893	3,972,229
1872	336,000	1894	3,967,253
1873	392,000	1895	4,156,074
1874	799,936	1896	3,954,028
1875	1,231,547	1897	4,611,865
1876	1,250,000	1898	4,618,842
1877	1,300,000	1899	5,177,479
1878	1,350,000	1900	5,202,939
1879	1,400,000	1901	5,617,499
1880	1,461,116	1902	5,904,766
1881	1,960,000	1903	6,419,811

a United States census, fiscal year.

KANSAS.

Total production in 1903, 5,839,976 short tons; spot value, $8,871,953.

Since 1896 the coal production in Kansas has increased each year. The output in 1903 exceeded that of 1896 by more than 100 per cent. As compared with 1902, the production last year shows an increase of 573,911 short tons, or 10.9 per cent, in quantity, and $2,009,166, or 29 per cent, in value. The average price per ton obtained in 1903 ($1.52) was the highest of any year of which there is record. During 1903 the total number of men employed in the coal mines of Kansas was 10,924, who made an average of 215 days of nine hours, as compared with 9,461 men with an average of 220 days in 1902, and of 9,928 men with an average of 224 days in 1901. The production in 1903 was equivalent to an average of 534.6 tons per man for the year; in 1902 the average was 556.6 tons per man, and in 1901 493.6 tons per man. The average production per man per day in 1903 was 2.49 tons, a slight decrease from 1902, which was 2.53 tons, and an improvement over 1901, which was 2.2 tons. The average number of hours per day made by the mine workers in 1903 was nine.

Of the total coal production of Kansas in 1903, 9,876 short tons, or 1.7 per cent, were mined by machines, as against 48,000 short tons, or

9.1 per cent of the total in 1902. The number of machines in use decreased from six in 1902 to five in 1903.

In the following tables is shown the statistics of production of coal in Kansas in 1902 and 1903, by counties, and the distribution of the product for consumption:

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.

Coal production of Kansas in 1903, 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.*				
Bourbon	....	3,006	1,414	....	4,420	$9,028	$2.04	170	15
Cherokee	1,991,840	83,479	83,877	3,701	2,062,897	3,051,769	1.48	210	3,461
Crawford	3,030,029	55,786	46,770	10	3,132,595	4,344,451	1.39	217	5,337
Leavenworth	274,653	94,178	13,997	....	382,828	830,704	2.17	259	1,044
Linn	43,000	4,217	400	....	47,617	83,201	1.75	199	120
Osage	165,424	28,927	376	....	194,727	515,803	2.65	176	896
Other counties a	4,900	3,417	....	....	8,317	22,201	2.67	153	51
Small mines	....	6,575	....	....	6,575	14,796	....	....	....
Total	5,509,846	229,585	96,834	3,711	5,839,976	8,871,953	1.52	215	10,924

a Cloud, Ellsworth, Franklin, Pottawatomie, and Republic.

The most important increases in production during 1903 were made by the two principal producing counties—Crawford, 251,321 short tons, and Cherokee, 213,001 short tons. The following table shows the production, by counties, in Kansas during the last five years, and the increases and decreases in 1903 as compared with 1902:

Coal production of Kansas, 1899–1903.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Atchison	3,000	2,000	3,000	(a)	....	....	....
Cherokee	1,162,142	1,547,471	1,550,198	1,849,896	2,062,897	213,001	....
Cloud	....	....	....	7,524	2,400	....	5,124
Crawford	1,951,504	2,307,130	2,708,701	2,881,274	3,132,595	251,321	....
Franklin	14,050	4,420	11,460	4,999	4,900	....	99
Leavenworth	312,845	250,229	248,476	291,681	382,828	91,147	....
Linn	17,260	26,640	26,380	29,780	47,617	17,837	....
Osage	262,331	196,998	222,293	192,781	194,727	1,946	....
Other counties and small mines	129,135	132,982	130,020	8,130	12,012	3,882	....
Total	3,852,267	4,467,870	4,900,528	5,266,065	5,839,976	b 573,911	....

a Included in other counties. b Net increase.

The distribution of the product for consumption, the value, and the statistics of labor employed during the last fifteen years have been as follows:

Distribution of the coal product of Kansas, 1889–1903.

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	183	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	258,933	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
1903	5,509,846	229,585	96,884	3,711	5,839,976	8,871,953	1.52	215	10,924

The earliest record of coal production in Kansas shows that that State produced in 1869 a total of 36,891 tons. From 1870 to 1880 the production has been estimated from the best information obtainable, and since 1880 it has been collected by the statistical division of the United States Geological Survey. The record is shown in the following table:

Coal production of Kansas, 1869–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1869	36,891	1887	1,596,879
1870 a	32,938	1888	1,850,000
1871	41,000	1889	2,221,043
1872	44,800	1890	2,259,922
1873	56,000	1891	2,716,705
1874	85,000	1892	3,007,276
1875	150,000	1893	2,652,546
1876	225,000	1894	3,388,251
1877	300,000	1895	2,926,870
1878	375,000	1896	2,884,801
1879	460,000	1897	3,054,012
1880 a	771,442	1898	3,406,555
1881	840,000	1899	3,852,267
1882	750,000	1900	4,467,870
1883	900,000	1901	4,900,528
1884	1,100,000	1902	5,266,065
1885	1,212,057	1903	5,839,976
1886	1,400,000		

a United States census, fiscal year.

KENTUCKY.

Total production in 1903, 7,538,032 short tons; spot value, $7,979,342.

Kentucky is one of the thirteen States whose coal production has increased annually since the period of prosperity began in 1896. In that year Kentucky produced 3,333,478 short tons, having a total value of $2,684,306, or an average of $0.78 per ton. The production in 1903 was two and one-fourth times the output of 1896, while the value was nearly three times as great, the average price per ton showing a gain of $0.28, or 36 per cent. Compared with 1902 the production last year shows a gain of 771,048 short tons, or 11.4 per cent, in quantity, and of $1,312,375, or 19.7 per cent, in value. The average price per ton obtained in 1903 ($1.06) is the first in over fifteen years that has exceeded $1.

The statistics for 1903 show that during that year there were 14,354 men employed in the coal mines of the State. The average time made per man was 207 days of nine hours each, and the average tonnage per man per year was 525.2 tons. In 1902 there were 13,727 men employed on an average of 209 days, and the average production for each man was 493 tons. In 1901 the average production was 530.7 tons per man. The production per man per day was 2.49 tons in 1901, 2.35 in 1902, and 2.54 in 1903. The small average in both daily and yearly production per man in 1902 was due to the fact that the statistics of labor employed in the small mines of the State included in the report of that year were not included in either of the reports for 1901 and 1903. The mine workers made an average of nine hours per day during 1903.

Of the total production in 1903, 2,843,805 short tons were mined by the use of machines. In 1902, 3,091,626 short tons were machine mined. There were 308 machines in use in 1903, and 318 in 1902.

The following tables present the statistics of production of coal in Kentucky in 1902 and 1903, by counties, and the distribution of the product for consumption:

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	391,883	.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	71
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	109
Union	279,211	23,909	9,958	2,678	315,786	338,791	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	12,181	675	....	16,685	22,507	1.35	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.

Coal production of Kentucky in 1903, 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	289,421	8,440	9,150	85,005	392,016	$427,054	$1.09	184	1,112
Boyd	245,491	....	....	....	245,491	219,966	.90	249	398
Breathitt	30,600	1,135	995	....	32,730	42,938	1.31	203	89
Carter	256,321	8,505	400	....	265,226	289,130	1.09	194	691
Clay	....	6,200	....	....	6,200	5,700	.92	224	19
Daviess	12,288	31,548	450	....	44,286	48,582	1.10	217	90
Hancock	33,658	3,374	....	....	37,032	42,878	1.16	225	80
Henderson	131,598	42,910	4,363	....	178,871	197,622	1.10	219	418
Hopkins and Christian	1,660,031	33,448	49,968	99,500	1,842,947	1,719,105	.93	241	2,178
Johnson	69,000	7,200	900	....	77,100	79,545	1.03	160	224
Knox	526,077	9,810	7,670	....	543,557	610,649	1.12	234	940
Laurel	381,975	4,750	5,563	....	392,288	409,319	1.04	208	862
Lawrence	46,844	12,273	7,709	....	66,826	71,305	1.07	199	169
Lee	47,196	200	175	....	47,571	61,986	1.30	268	121
Leslie	....	3,800	....	....	3,800	4,100	1.08	138	19
McLean	118,732	6,632	2,505	....	127,869	124,465	.97	226	159
Magoffin	....	10,200	....	....	10,200	11,750	1.15	232	28
Morgan	58,578	1,725	75	....	60,378	134,080	2.22	192	155
Muhlenberg	770,849	12,618	15,425	....	798,892	772,597	.97	197	1,818
Ohio	555,232	18,172	12,668	....	586,072	593,778	1.01	189	1,079
Owsley	1,400	5,056	2,000	40	8,496	14,614	1.72	134	38
Pike	18,641	2,550	....	....	21,191	23,206	1.10	129	64
Pulaski	191,184	2,365	2,738	....	196,287	281,323	1.43	234	476
Rockcastle	51,411	5,440	50	....	56,901	66,071	1.16	144	158
Union	304,346	26,838	13,315	5,126	349,625	412,862	1.18	198	621
Webster	340,531	16,704	11,325	3,000	371,560	338,770	.91	224	539
Whitley	660,272	41,830	8,645	....	710,747	900,276	1.27	190	2,185
Other counties[a]	3,647	22,700	3,500	....	29,847	37,040	1.24	164	99
Small mines	....	34,026	....	....	34,026	38,681	....	....	....
Total	6,805,823	380,449	159,589	192,671	7,538,032	7,979,342	1.06	207	14,354

[a] Butler, Caldwell, Carroll, Crittenden, Floyd, Greenup, Knott, Letcher, Martin, Menifee, and Warren.

In 1902 there were three counties in which the production was less than in the preceding year, and in 1903 there were five counties in which the production decreased. These were Bell, Butler, Carter, Johnson, and Laurel. The most important increase was made by the principal producing county, Hopkins, which showed a gain of 188,637 short tons, or about 25 per cent of the total increase.

The production of the State, by counties, during the last five years, with the increases and decreases in 1903 as compared with 1902, is shown in the following table:

Coal production of Kentucky, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Bell	152,934	224,500	333,235	461,768	392,016	....	69,752
Boyd	171,438	170,931	173,930	242,021	245,491	3,470	....
Breathitt and Lee	21,000	33,416	37,326	60,524	80,301	19,777	....
Butler	35,174	32,482	18,802	12,868	3,600	....	9,268
Carter	184,784	248,756	245,526	281,401	265,226	....	16,175
Christian, Daviess, and Hancock	12,484	114,258	97,645	125,708	180,544	54,836	....
Greenup	4,225	....	....	....	3,167	3,167	....
Henderson	136,623	135,775	169,365	158,471	178.871	20,400	....
Hopkins	1,204,683	1,371,826	1,362,299	1,555,084	1,743,721	188,637	....
Johnson	12,464	19,164	a 37,692	126,473	77,100	....	49,373
Knox	235,682	308,969	283,706	481,819	543,557	61,738	....
Laurel	349,719	351,786	315,698	402,997	392,288	....	10,709
Lawrence	49,418	46,316	46,924	57,387	66,826	9,439	....
McLean	29,795	20,454	17,716	54,568	127,869	73,301	....
Muhlenberg	414,332	399,944	532,840	700,700	798,892	98,192	....
Ohio	505,913	552,665	502,974	541,226	586,072	44,846	....
Pulaski	103,469	92,960	138,787	159,497	196,287	36,790	....
Rockcastle	....	8,000	15,000	3,660	56,901	53,241	....
Union	185,405	268,133	277,337	315,786	349,625	33,839	....
Webster	122,391	110,565	122,116	278,042	371,560	93,518	....
Whitley	525,317	673,069	591,068	687,831	710,747	22,916	....
Other counties and small mines	150,000	150,000	150,000	59,153	167,371	108,218	....
Total	4,607,255	5,328,964	5,469,986	6,766,984	7,538,032	b 771,048	....

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 part belong to the Central field, of which Illinois and Indiana form the greater part. For a number of years the counties in the western part have produced more than half of the total output of the State. As a comparison between the two sections is of interest, the following table has been prepared, showing the production in the districts by counties for the last five years, with the increases and decreases in 1903 compared with those of 1902:

Coal production of the eastern district of Kentucky, 1899–1903.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase in 1903.	Decrease in 1903.
Bell	152,934	224,500	333,235	461,768	392,016	....	69,752
Boyd	171,438	170,931	173,930	242,021	245,491	3,470	....
Breathitt	15,700	16,416	18,540	23,873	32,730	8,857	....
Carter	184,784	248,756	245,526	281,401	265,226	....	16,175
Greenup	4,225	....	....	....	3,167	3,167	....
Johnson	12,464	19,161	[a]37,692	126,473	77,100	....	49,373
Knox	235,682	303,969	283,706	481,819	543,557	61,738	....
Laurel	349,719	351,786	315,698	402,997	392,288	....	10,709
Lawrence	49,418	46,316	46,924	57,387	66,826	9,439	....
Lee	5,300	17,000	18,786	36,651	47,571	10,920	....
Pulaski	103,469	92,960	138,787	159,497	196,287	36,790	....
Rockcastle	....	8,000	15,000	3,660	56,901	53,241	....
Whitley	525,317	673,069	591,068	687,831	710,747	22,916	....
Other counties and small mines	....	....	90,000	40,000	129,065	89,065	....
Total	1,810,450	2,172,867	2,308,892	3,005,378	3,158,972	[b]153,594	....

[a] Includes Morgan County.

[b] Net increase.

Coal production of the western district of Kentucky, 1899–1903.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase in 1903.	Decrease in 1903.
Butler	35,174	32,482	18,802	12,868	3,600	....	9,268
Christian	....	93,931	73,220	87,353	99,226	11,873	....
Daviess	2,464	13,272	16,205	20,518	44,286	23,768	....
Hancock	10,020	7,050	8,220	17,837	37,032	19,195	....
Henderson	136,628	135,775	169,365	158,471	178,871	20,400	....
Hopkins	1,204,683	1,371,826	1,362,299	1,555,084	1,743,721	188,637	....
McLean	29,795	20,454	17,716	54,568	127,869	73,301	....
Muhlenberg	414,332	399,944	532,840	700,700	798,892	98,192	....
Ohio	505,913	552,665	502,974	541,226	586,072	44,846	....
Union	185,405	268,133	277,337	315,786	349,625	33,839	....
Webster	122,391	110,565	122,116	278,042	371,560	93,518	....
Other counties and small mines	....	....	60,000	19,153	38,306	19,153	....
Total	2,646,805	3,006,097	3,161,094	3,761,606	4,379,060	[a]617,454	....

[a] Net increase.

The distribution of the product for consumption, with the value and statistics of labor employed, during the last fifteen years, is as follows:

Distribution of the coal product of Kentucky, 1889–1903.

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	55,038	54,833	3,602,097	2,828,329	.79	178	7,988
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
1903	6,805,323	380,449	159,589	192,671	7,538,032	7,979,342	1.06	207	14,354

The United States Census for 1840 credits the State of Kentucky with a coal production of 23,527 tons. From that year until 1870, when the Eighth Census reported a production of 150,582 short tons, the record is blank. Since 1870 the production has been as follows:

Annual coal production of Kentucky, 1870–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1870 [a]	150,582	1887	1,933,185
1871	250,000	1888	2,570,000
1872	380,800	1889	2,899,755
1873	300,000	1890	2,701,496
1874	360,000	1891	2,916,069
1875	500,000	1892	3,025,313
1876	650,000	1893	3,007,179
1877	850,000	1894	3,111,192
1878	900,000	1895	3,357,770
1879	1,000,000	1896	3,333,478
1880 [a]	946,288	1897	3,602,097
1881	1,232,000	1898	3,887,908
1882	1,300,000	1899	4,607,255
1883	1,650,000	1900	5,828,964
1884	1,550,000	1901	5,469,986
1885	1,600,000	1902	6,766,984
1886	1,550,000	1903	7,538,032

[a] United States census, fiscal year.

MARYLAND.

Total production in 1903, 4,846,165 short tons; spot value, $7,189,784.

It is well known that the somewhat limited areas of actual productive territory in Maryland have been pretty well taken up, and that no new developments in that particular territory are to be expected in the future. Operations will probably be confined, until the fields are practically exhausted, to the extension of the mines already opened, and it is not believed that there will be any permanent increase in the annual production of the State. This condition is exemplified by the showing for 1903, when the production throughout the United States generally increased, while the output from Maryland shows a decline of 425,444 short tons. An increase is shown in the value of the product, however, of $1,609,915, or 29 per cent. It is thus seen that, while the State did not share in the increased tonnage, the operators have been benefited by the general advance in price which was distributed throughout the coal-producing region by the anthracite coal strike of the preceding year.

In 1903 there were 5,859 men engaged in the production of 4,846,165 tons, or an average of 827.1 tons per man for the year. In 1902 each man produced an average of 904.6 tons, and in 1901 of 958.8 tons. The average production per man per day was 3.66 tons in 1901, 3.74 tons in 1902, and 3.78 tons in 1903. About 98 per cent of the total production of Maryland was obtained from Alleghany County, and the remaining small quantity from Garrett County.

Since 1889 the statistics of production, the labor employed, and the distribution of the product for consumption have been as follows:

Distribution of the coal product of Maryland, 1889–1903.

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	5,338
1902	5,187,175	48,631	35,803	5,271,609	5,579,869	1.06	242	5,827
1903	4,752,716	53,022	40,427	4,846,165	7,189,784	1.48	219	5,859

Maryland and the adjoining counties in West Virginia, which make up what is known as the Cumberland region, constitute the only districts outside of the anthracite region of Pennsylvania where records of coal production have been kept from the earlier years. These districts have been commonly known as the Georges Creek or Cumberland and the 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 fields 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	1,871,728	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)
1903	2,844,162	222,571	182,587	3,249,320	(a)	(a)	(a)
Total	53,499,905	12,407,481	6,063,119	71,970,505	8,609,691	4,219,351	12,829,042

[a] Merged in Cumberland and Pennsylvania figures.

Maryland and West Virginia from 1842 to 1903, inclusive.

[Long tons.]

Frostburg region.				Piedmont region.		Total.			Aggregate.
Georges Creek and Cumberland R. R.									
By Chesapeake and Ohio Canal.	By Pennsylvania R. R.	Local and Baltimore and Ohio R. R.	Total.	Georges Creek R. R.	Hampshire R. R. by Baltimore and Ohio R. R.	Baltimore and Ohio R. R. and local.	Chesapeake and Ohio Canal.	Pennsylvania R. R.	
						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
				78,725		376,219	157,760		533,979
				181,303		503,836	155,845		659,681
				227,245	65,570	478,486	183,786		662,272
				269,216	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	344,954	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
	583,954	143,856	727,810	2,055,046		b4,672,341	222,571	1,137,264	6,032,176
565,001	12,994,400	4,238,636	17,818,037	23,786,827	1,475,969	89,427,309	18,507,283	25,423,355	133,357,947

b Includes 205,901 tons used on line of Cumberland and Pennsylvania Railroad and its branches, and at Cumberland and Piedmont; also 863,970 tons used by the Baltimore and Ohio Railroad Company in locomotives, rolling mills, etc.

MICHIGAN.

Total production in 1903, 1,367,619 short tons; spot value, $2,707,527.

The coal-mining industry of Michigan during 1902 was considerably demoralized by labor troubles, which resulted in a decrease in the production for the State of 276,523 short tons or more than 22 per cent as compared with the output in 1901.

Comparative peace reigned throughout 1903, and, stimulated by a general shortage in fuel and unprecedented demand, the production of Michigan increased to 1,367,619 short tons, a gain as compared with 1902 of 402,901 short tons or 41.8 per cent, and exceeding by 126,000 short tons or a little over 10 per cent the production in 1901, which prior to 1903 was the banner year for coal production in Michigan. The increased production was attended with an advance in the average price per ton from $1.71 in 1902 to $1.97 in 1903. The total value increased from $1,653,192 to $2,707,527, a gain of $1,054,335 or 63.8 per cent.

On account of the strikes in 1902, the average time made by the mine workers in that year was 171 days against 247 days in 1901. The average time made in 1903 was 222 working days. The average number of men employed during each of the past three years was 2,276 in 1901, 2,344 in 1902, and 2,768 in 1903. The average production for each employee in 1903 was 494.1 tons, against 411.6 tons in 1902 and 545.4 tons in 1901. That the mine workers during 1902 made the best of the time in which they were employed is shown by the fact that in that year the average production per day per man was 2.4 tons, while in 1901 it was 2.21 tons, and in 1903 it was 2.23 tons. The average length of the working day in Michigan in 1903 was eight hours.

The statistics of production by counties, in 1902 and 1903, are shown in the following tables:

Coal production of Michigan 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.*				
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

Coal production of Michigan in 1903, 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	288,284	24,215	12,522	325,021	$607,091	$1.87	206	714
Eaton and Jackson		29,041	1,659	30,700	78,345	2.55	294	100
Saginaw	914,882	70,421	26,595	1,011,898	2,022,091	2.00	224	1,954
Total	1,203,166	123,677	40,776	1,367,619	2,707,527	1.97	222	2,768

The development of the Michigan coal fields has been on a relatively important scale during the last seven years only. Prior to 1897 there were but four years in which the production exceeded 100,000 tons; these were 1880, 1881, 1882, and 1895. In 1897 it increased more than 130,000 tons over 1896, amounting to 223,592 short tons. Since then it has increased each year, with the exception of 1902, when, as previously stated, the output was decreased by reason of strikes among the mine workers.

The following table shows the production in the State in 1860 and each year since 1868:

Coal production of Michigan, 1860–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1860	2,320	1886	60,434
1868	28,000	1887	71,461
1869	29,980	1888	81,407
1870 [a]	28,150	1889	67,431
1871	32,000	1890	74,977
1872	33,600	1891	80,307
1873	56,000	1892	77,990
1874	58,000	1893	45,979
1875	62,500	1894	70,022
1876	66,000	1895	112,322
1877	69,197	1896	92,882
1878	85,322	1897	223,592
1879	82,015	1898	315,722
1880 [a]	100,800	1899	624,708
1881	112,000	1900	849,475
1882	135,339	1901	1,241,241
1883	71,296	1902	964,718
1884	36,712	1903	1,367,619
1885	45,178		

[a] United States census, fiscal year.

The following table shows the distribution of the coal product in Michigan, 1892 to 1903:

Distribution of the coal product of Michigan, 1892–1903.

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
1903	1,203,166	123,677	40,776	1,367,619	2,707,527	1.97	222	2,768

MISSOURI.

Total production in 1903, 4,238,586 short tons; spot value, $6,834,297.

For the first time in her history the coal production of Missouri has exceeded a total of 4,000,000 tons. Prior to 1903 the largest tonnage made by the State was in 1888, when a total of 3,909,967 short tons of coal were mined. In 1889 the production dropped back to 2,557,823 short tons, and for the next seven years the production was without much change either way. From 1896 to the close of 1903 the production has increased steadily, indicating a steady growth in population and industrial development. As has previously been pointed out, the market for the coal output of Missouri is practically restricted to comparatively local consumption. It is almost entirely surrounded by other important coal-producing States, where the mining conditions are, as a general thing, more favorable to cheap production than in Missouri, and the larger cities of the State are supplied largely from mines outside of her borders. The opportunity for extending the markets for Missouri coal is limited to the developments within the State itself.

Comparing the production in 1903 with that of 1902, the State shows a gain of 348,432 short tons, or 9 per cent in quantity, and $1,459,655, or 27 per cent in value. The average price per ton advanced from $1.38 in 1902 to $1.61 in 1903, this being the highest price obtained in any year for which there is any record.

In 1903 there were employed in the coal mines of Missouri 9,544 men, as compared with 9,742 in 1902 and 9,871 in 1901. The average number of days worked was 215 in 1903, 202 in 1902, and 223 in 1901.

The average production per man per year was 444.1 tons in 1903, 399.5 in 1902, and 395.3 in 1901. The average tonnage per man per day was 2.07 in 1903, 1.98 in 1902, and 1.73 in 1901, showing a steady increase in efficiency during the last two years.

The statistics of production in 1902 and 1903, by counties, are shown in the following tables:

Coal production of Missouri 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.*				
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
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.

Coal production of Missouri in 1903, 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	511,854	10,032	5,089	526,975	$767,118	$1.46	224	1,078
Audrain	15,404	10,643	788	26,835	56,343	2.10	223	93
Barton	184,469	6,537	2,810	193,816	276,301	1.43	212	382
Bates	139,892	8,642	1,429	149,963	193,690	1.29	191	318
Boone	2,760	16,952	40	19,752	33,057	1.67	157	82
Callaway	9,900	15,532	405	25,837	43,694	1.73	265	76

Coal production of Missouri in 1903, by counties—Continued.

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.*				
Henry	32,655	26,285	770	59,710	$120,397	$2.02	191	203
Lafayette	590,407	40,870	8,203	639,480	1,266,631	1.98	222	1,847
Linn	43,200	20,824	2,295	66,319	135,620	2.04	256	204
Livingston		4,095		4,095	8,474	2.07	146	18
Macon	1,102,171	8,081	70,401	1,180,653	1,732,715	1.47	226	1,864
Putnam	108,710	3,115	915	112,740	206,837	1.83	200	297
Ralls	7,206	9,979		17,185	27,737	1.61	126	63
Randolph	573,947	19,291	11,002	604,240	871,392	1.44	225	1,223
Ray	267,404	24,236	5,282	296,922	554,104	1.87	228	862
Schuyler	6,850	2,355	66	9,271	14,483	1.56	125	38
Vernon	168,885	2,873	9,600	181,358	271,093	1.49	161	427
Other counties[a]	48,974	35,300	4,702	88,976	190,097	2.14	172	469
Small mines		34,459		34,459	65,014			
Total	3,814,688	300,101	123,797	4,238,586	6,834,297	1.61	215	9,544

[a] Caldwell, Cedar, Chariton, Clay, Dade, Grundy, Howard, Jackson, Johnson, Lincoln, Monroe, Montgomery, Morgan, Pettis, and St. Clair.

Notwithstanding the fact that the total production of the State increased 348,432 tons in 1903 over the preceding year, there were 13 counties in the State in which the production diminished and 8 counties (exclusive of the unimportant counties and the production of small mines) in which the tonnage increased. The most important gains were made in Adair County, 195,816 short tons; Randolph, 180,073 tons; Macon, 115,927 tons, and Lafayette, 95,679 tons. The greatest decrease was borne by Bates County, whose output declined from 354,707 short tons in 1902 to 149,963 short tons in 1903, a loss of 204,744 tons. The increases and decreases in the other counties were comparatively unimportant.

In the following table is shown the coal production of the State, by counties, during the last five years, and the increases and decreases in 1903 as compared with 1902:

Coal production in Missouri, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Adair	175,452	244,314	358,011	331,159	526,975	195,816	
Audrain	45,907	44,074	35,916	26,208	26,835	627	
Barton	111,468	166,592	144,354	200,346	193,816		6,530
Bates	456,797	270,712	281,020	354,707	149,963		204,744
Boone	20,280	18,619	22,629	27,006	19,752		7,254
Caldwell	48,100	34,100	20,430	16,000	11,485		4,515
Callaway	23,210	16,435	28,008	26,422	25,837		585

Coal production in Missouri, 1899–1903, by counties—Continued.

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Cole	2,500	....	....	....	....	....	....
Grundy	42,071	39,239	42,361	34,936	25,565	....	9,371
Henry	95,071	81,010	82,586	98,831	59,710	....	39,121
Jackson	32,000	16,700	20,000	21,000	8,500	....	12,500
Johnson	1,500	4,939	11,255	5,540	1,458	....	4,082
Lafayette	369,253	457,858	438,922	543,801	639,480	95,679	....
Linn	84,928	71,311	85,256	81,108	66,319	....	14,789
Livingston	1,150	1,200	900	2,138	4,095	1,957	....
Macon	539,543	836,248	1,040,976	1,064,726	1,180,653	115,927	....
Montgomery and Morgan	1,855	2,146	3,474	a 4,101	7,583	3,482	....
Putnam	184,655	111,626	133,397	127,983	112,740	....	15,243
Ralls	22,640	20,145	23,688	19,372	17,185	....	2,187
Randolph	304,962	442,456	403,403	424,167	604,240	180,073	....
Ray	206,622	216,617	267,432	235,066	296,922	61,856	....
Vernon	185,214	322,827	238,070	218,339	181,358	....	36,981
Other counties and small mines	120,636	120,935	120,000	27,198	78,115	50,917	....
Total	3,025,814	3,540,103	3,802,088	3,890,154	4,238,586	b 348,432	....

a Montgomery County only. b Net increase.

The distribution of the coal product in the State since 1889 has been as follows:

Distribution of the coal product of Missouri, 1889–1903.

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	2,393,815	249,662	45,844	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	4,280,828	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
1903	3,814,688	300,101	123,797	4,238,586	6,834,297	1.61	215	9,544

The United States Census of 1840 reports the coal production of Missouri in that year as 9,972 tons. Since 1840 the production has been as shown in the following table, the output for the years 1841 to

1869, inclusive, being largely estimated from the best information available:

Coal production of Missouri, 1840–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1840	9,972	1872	784,000
1841	12,000	1873	784,000
1842	15,000	1874	789,680
1843	25,000	1875	840,000
1844	35,000	1876	1,008,000
1845	50,000	1877	1,008,000
1846	68,000	1878	1,008,000
1847	80,000	1879	1,008,000
1848	85,000	1880	*b* 844,304
1849	90,000	1881	1,960,000
1850	100,000	1882	2,240,000
1851	125,000	1883	2,520,000
1852	140,000	1884	2,800,000
1853	160,000	1885	3,080,000
1854	175,000	1886	1,800,000
1855	185,000	1887	3,209,916
1856	200,000	1888	3,909,967
1857	220,000	1889	2,557,823
1858	240,000	1890	2,735,221
1859	260,000	1891	2,674,606
1860 *a*	280,000	1892	2,773,949
1861	300,000	1893	2,897,442
1862	320,000	1894	2,245,089
1863	360,000	1895	2,372,393
1864	375,000	1896	2,331,542
1865	420,000	1897	2,665,626
1866	450,000	1898	2,688,321
1867	500,000	1899	3,025,814
1868	541,000	1900	3,540,103
1869	550,000	1901	3,802,088
1870 *b*	621,930	1902	3,890,154
1871	725,000	1903	4,238,586

a Census figures for 1860 are 3,880 short tons, but it is evidently an error.
b United States census, fiscal year.

MONTANA.

Total production in 1903, 1,488,810 short tons; spot value, $2,440,846.

Montana's coal production has shown very little variation during the last nine years, indicating that there has been during that time very little, if any, industrial progress. The maximum output was reached in 1900, when the production amounted to 1,661,775 short tons. The smallest production in the last nine years was in 1901, when it fell off to 1,396,081 short tons. The tonnage mined in 1903 was somewhat less than the average since 1894, and there were only two years since that time (1898 and 1901) when the output was less than in 1903.

Compared with 1902, the production of 1903 shows a loss of 72,013 short tons, or 4.6 per cent. The State participated, however, in the general advance in price, and the value of the product in 1903 was only $2,601 less than that of the preceding year. The average price per ton advanced from $1.57 in 1902 to $1.64 in 1903. This is the highest figure reached since 1897.

There were employed in the coal mines of the State during 1903 a total of 2,155 men, an increase of 217 over 1902. The average working time, however, shows a decrease of 16 days. The yearly production for each man employed in 1903 was 691 short tons as against 805 tons in 1902 and 647 tons in 1901. The average daily production in 1903 was less than in either of the two previous years, the figures being respectively 2.8 tons in 1901, 2.98 tons in 1902, and 2.72 tons in 1903.

The statistics of production for the last two years, by counties, are as follows:

Coal production of Montana 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	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.

Coal production of Montana in 1903, 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	559,305	10,431	20,261	....	589,997	$797,525	$1.35	303	697
Cascade	666,272	16,494	32,496	17,802	733,064	1,222,613	1.67	251	887
Choteau	2,625	7,200	50	....	9,875	24,000	2.43	226	26
Fergus	1,000	8,734	....	....	9,734	38,553	3.96	215	31
Park	14,120	4,640	5,150	62,134	86,044	258,132	3.00	250	240
Other counties[a]	44,000	2,655	5,471	7,220	59,346	98,473	1.66	146	274
Small mines	....	750	....	....	750	1,550	....	....	....
Total	1,287,322	50,904	63,428	87,156	1,488,810	2,440,846	1.64	254	2,155

[a] Deerlodge and Gallatin.

It will be seen from the following table that the decrease in production was distributed pretty generally over the State, there being but one county in six which did not sustain a loss. The greatest percentage of loss was in Gallatin County, where the product fell off almost exactly one-third.

Production of coal in Montana, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Carbon	337,525	393,877	498,560	604,954	589,997	....	14,957
Cascade	965,378	1,123,395	789,407	761,572	733,064	....	28,508
Choteau	6,885	5,757	5,050	10,772	9,875	....	897
Fergus	900	900	500	5,200	9,734	4,534	....
Gallatin	56,671	51,671	24,583	88,000	58,696	....	29,304
Park	128,850	86,025	77,981	89,640	86,044	....	3,596
Other counties	242	150	....	685	a 1,400	715	....
Total	1,496,451	1,661,775	1,396,081	1,560,823	1,488,810	....	b 72,013

a Includes production of small mines. b Net decrease.

The distribution of the product for consumption, the value, and the statistics of labor employed in the coal mines of Montana since 1889 are shown in the following table:

Distribution of the coal product of Montana, 1889–1903.

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	1,156
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	2,156
1902	1,385,100	40,719	39,023	95,981	1,560,823	2,443,447	1.57	270	1,938
1903	1,287,322	50,904	63,428	87,156	1,488,810	2,440,846	1.64	254	2,155

The earliest record of coal production in Montana is contained in the census report for 1880, in which year the output was given at 224 tons. The second volume of Mineral Resources shows that in 1883 the output of the State amounted to 19,795 short tons. In the twenty-one years of coal mining since 1883, inclusive, the production has been as follows:

Coal production of Montana, 1883–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1883	19,795	1894	927,395
1884	80,376	1895	1,504,193
1885	86,440	1896	1,543,445
1886	49,846	1897	1,647,882
1887	10,202	1898	1,479,803
1888	41,467	1899	1,496,451
1889	363,301	1900	1,661,775
1890	517,477	1901	1,396,081
1891	541,861	1902	1,560,823
1892	564,648	1903	1,488,810
1893	892,309		

NEW MEXICO.

Total production in 1903, 1,541,781 short tons; spot value, $2,105,785.

Following two years of decreasing production, the coal mining industry in New Mexico took a decided spurt in 1903, and while the records show that the number of men employed were even less than in 1902, there was a marked increase in the average amount of working time and a gain in the total output of 493,018 short tons, or 47 per cent. The gain in value was somewhat less in proportion, owing to a decline in the average price from $1.43 in 1902 to $1.37 in 1903. The increase in value was substantial, however, amounting to $605,555, or 40 per cent. Part of the increase in New Mexico's production would probably have gone to Colorado had the industry in the latter State been free from labor disturbances.

The most striking feature connected with the coal-mining industry in New Mexico during the last three years has been the increased daily and yearly production per man employed. In 1901, 2,478 men were employed for an average of 224 days in the production of 1,086,546 short tons of coal, being equivalent to 438 tons per man for the year, and of 1.96 tons per man per day. In 1902, 1,849 men worked an average of 217 days and produced 1,048,763 short tons, or at the rate of 567 tons per man for the year, and of 2.61 tons per man per day. In 1903, 1,789 men (60 less than in 1902) produced 1,541,781 short tons and worked an average of 260 days, the rate of production being 862 tons per man per year, and 3.31 tons per man per day of nine hours.

The statistics of production in 1902 and 1903, by counties, are as follows:

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 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.

Coal production of New Mexico in 1903, 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.*				
Colfax	630,709	15,079	15,285	62,713	723,786	$874,837	$1.21	281	664
McKinley	553,673	4,669	11,020		569,362	789,003	1.39	241	757
Santa Fe	65,864	364	9,307		75,535	138,290	1.83	289	126
Other counties[a]	163,937	4,422	4,664		173,023	303,555	1.75	245	242
Small mines		75			75	100			
Total	1,414,183	24,609	40,276	62,713	1,541,781	2,105,785	1.37	260	1,789

[a] Lincoln, Rio Arriba, Sandoval, San Juan, and Socorro.

As shown in the following table, the increased production in 1903 was almost entirely confined to the two counties in which there has been the greatest amount of development—Colfax and McKinley (formerly Bernalillo). The losses in the other three counties were not, however, of much importance.

Coal production of New Mexico, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
McKinley	493,310	450,646	516,583	432,108	569,362	137,254	....
Colfax	368,378	388,480	249,296	346,373	723,786	377,413	....
Lincoln	12,737	150,442	156,621	99,000	97,229	....	1,771
Rio Arriba	32,000	45,800	38,942	47,600	35,500	....	12,100
Sante Fe	137,534	252,731	106,454	90,895	75,535	....	15,360
Other counties	6,760	11,200	18,700	32,787	40,369	7,582	....
Total	1,050,714	1,299,299	1,086,546	1,048,763	1,541,781	[a] 493,018	....

[a] Net increase.

The distribution of the product for consumption, the value, and the statistics of labor employed in the coal mines of New Mexico since 1889 are shown in the following table:

Distribution of the coal product of New Mexico, 1889–1903.

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	1,883
1896	607,819	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	58,108	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
1903	1,414,183	24,609	40,276	62,713	1,541,781	2,105,785	1.37	260	1,789

Since 1882, the first year of which there is any record available, the coal production of New Mexico has been as follows:

Coal production of New Mexico, 1882–1903.

[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	1903	1,541,781

NORTH CAROLINA.

Total production in 1903, 17,309 short tons; spot value, $25,300.

As the operations of the Richmond basin have been practically abandoned, the production in North Carolina represents the entire output of Tertiary coal in the United States. The Cumnock mines in the Deep River basin, Chatham County, furnish the total product. They were opened in 1889. Since that time the statistics of production have been as follows:

Distribution of the coal product of North Carolina, 1891–1903.

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
1903	14,429	87	2,793	17,309	25,300	1.47	264	40

Coal production of North Carolina, 1889–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1889	192	1897	21,280
1890	10,262	1898	11,495
1891	20,355	1899	26,896
1892	6,679	1900	17,734
1893	17,000	1901	12,000
1894	16,900	1902	23,000
1895	24,900	1903	17,309
1896	7,813		

NORTH DAKOTA.

Total production in 1903, 278,645 short tons; spot value, $418,005.

Coal production in North Dakota has increased steadily since 1897, accompanied by an uninterrupted advance in price, so that while the output in 1903 was about three and one-half times that of 1897, the value was more than five times as great. Compared with 1902 the production in 1903 shows an increase of 52,134 short tons, or 23 per cent, in quantity, and of $92,038, or 28.2 per cent, in value.

The entire product of North Dakota is lignite, which must depend upon a comparatively local market, as it does not stand transportation well, and can not compete with bituminous coals except when the price of the latter is quite high. The remoteness of North Dakota from the bituminous regions, however, encourages the use of the domestic lignites, of which there are extensive areas in the State.

The statistics of production, by counties, during the last two years have been as follows:

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	87
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.

Coal production of North Dakota in 1903, 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 McLean	100,465	6,310	1,985	108,760	$126,962	$1.17	274	99
Morton	10,500	3,000	....	13,500	14,335	1.06	198	28
Stark	39,864	6,700	200	46,764	55,190	1.18	224	72
Ward	57,782	38,573	1,726	98,081	199,964	2.04	189	228
Williams	6,060	2,725	150	8,935	17,710	1.98	73	59
Small mines	....	2,605	....	2,605	3,844	....	....	....
Total	214,671	59,913	4,061	278,645	418,005	1.50	198	486

The distribution of the product for consumption, the value, and the statistics of labor employed since 1889, and the total production since 1884 are shown in the following table:

Distribution of the coal product of North Dakota, 1889–1903.

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	218	402
1903	214,671	59,913	4,061	278,645	418,005	1.50	198	486

Coal production of North Dakota, 1884–1903.

[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	1903	278,645

OHIO.

Total production in 1903, 24,838,103 short tons; spot value, $31,932,327.

Since West Virginia took precedence of Ohio as a coal-producing State in 1896 the latter State has held fourth place in the quantity of coal produced, and until 1903 was third in rank in the value of the product. In 1903, however, the West Virginia product exceeded in value, as in quantity, the product of Ohio, and the latter State now holds fourth position both in quantity and value of her coal production. The supremacy thus gained by West Virginia will probably be maintained.

Compared with 1902 the production of coal in Ohio in 1903 shows an increase of 1,318,209 short tons, or 5.6 per cent, in quantity, and $4,978,538, or 18.5 per cent, in value. The production in the State has increased annually since 1897, when the output amounted to 12,196,942 short tons, showing that the production of 1903 was something over double that of 1897. The value of the product in 1903 was nearly 3.4 times that of 1897, while the average price per ton shows a gain of 14 cents, or 12.2 per cent, over 1902, and 51 cents, or 65 per cent, over 1897.

The returns for 1903 show that of the total product in that year 14,007,326 short tons, or 56.39 per cent, was machine mined, as compared with 12,094,641 short tons, or 51.42 per cent, in 1902. The number of mining machines in use in the State in 1903 was 724, as compared with 559 in 1902 and 376 in 1901. In the last named year the percentage of the machine-mined product of the total output was 47.3. Notwithstanding the increase in the use of mining machines, the total production per man shows a decided decrease in 1903 as compared with 1902, and in the latter year as compared with 1901, although there is a slight increase in the average production per man per day in 1903 as compared with the preceding year. In 1901 there were 32,111 men employed in the production of 20,943,807 short tons, or an average of

652 tons per man for the year. The average time per man made by the mine workers in 1901 was 198 days, showing an average daily production per man of 3.29 tons. In 1902 38,965 men were engaged in the production of 23,519,894 tons, or an average of 604 tons each for the year. As the average working time was 200 days, this made an average tonnage per man per day of 3.02 tons. In 1903 there were employed 41,936 men in the production of 24,838,103 tons, indicating an average of 592 tons per man for the year, and as the average working time last year was 194 days, the average tonnage per man per day was 3.05. Part of the decreased production per man was possibly due to a shorter number of hours for the day's work. In 1903 the men worked an average of eight hours per day, but no official statistics of this character were obtained for earlier years, and no exact comparisons can be made.

There was one county in Ohio, Athens, whose product in 1903 exceeded 3,000,000 tons. Four others, Belmont, Guernsey, Hocking, and Perry, each produced over 2,500,000 tons, and two, Jackson and Jefferson, produced within 100,000 tons of the latter quantity. There was only one other, Tuscarawas, whose production exceeded 1,000,000 tons. Of these eight leading counties, three, viz, Athens, Hocking, and Perry, comprise what is known as the Hocking Valley region. In this region are located some of the most important manufacturing interests of the State. These three counties in 1903 produced 8,662,650 short tons, or nearly 35 per cent of the State's total. The region has produced between 35 and 40 per cent of the total product of the State regularly in recent years.

Details of production by counties in 1902 and 1903, with the distribution of the product for consumption, are shown in the following tables:

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	368,289	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
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	238	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.

Coal production of Ohio in 1903, 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	3,351,800	36,131	37,027	....	3,424,958	$4,199,958	$1.23	163	5,485
Belmont	2,491,519	212,758	21,572	....	2,725,849	3,110,714	1.14	197	3,924
Carroll	220,046	24,392	10,002	....	254,440	354,707	1.39	220	490
Columbiana	827,218	60,557	19,550	....	907,325	1,167,664	1.29	230	1,478
Coshocton	401,332	52,068	608	....	454,008	625,132	1.38	222	984
Gallia	32,580	16,368	....	....	48,948	58,230	1.19	162	188
Guernsey	2,723,966	11,479	41,384	....	2,776,829	2,962,497	1.07	213	3,322
Harrison	253,361	4,524	1,162	....	259,047	369,181	1.43	246	317
Hocking	2,406,146	71,550	28,714	....	2,506,410	3,177,892	1.27	193	3,177
Holmes	23,300	17,985	53	....	41,338	57,416	1.39	197	115
Jackson	2,296,597	76,739	37,809	....	2,411,145	3,844,529	1.59	243	4,331
Jefferson	2,261,344	178,355	38,437	1,075	2,479,211	2,864,728	1.16	215	4,298
Lawrence	192,484	21,410	14,357	....	228,251	355,405	1.56	204	654
Mahoning	77,600	43,338	2,268	....	123,206	178,954	1.45	224	287
Medina	109,665	19,679	3,479	....	132,823	209,691	1.58	227	261
Meigs	252,458	60,130	4,300	....	316,888	398,349	1.26	185	760
Muskingum	187,523	93,521	605	....	281,649	330,953	1.18	139	747
Perry	2,638,392	54,508	38,382	....	2,731,282	3,298,805	1.21	150	4,962
Portage	100,297	6,397	3,100	....	109,794	237,644	2.16	190	325
Stark	711,515	148,298	51,052	....	910,865	1,923,025	2.11	180	2,218
Summit	30,658	8,020	3,440	....	42,118	69,108	1.64	206	98
Trumbull	4,959	4,968	725	....	10,652	27,762	2.61	219	35
Tuscarawas	1,141,274	125,684	12,678	....	1,279,636	1,532,023	1.20	182	2,680
Vinton	187,951	1,180	2,938	....	192,069	281,209	1.46	175	531
Wayne	66,751	1,519	1,600	....	69,870	130,648	1.87	162	223
Other counties[a]	103,056	2,400	500	....	105,956	154,580	1.46	188	170
Small mines	....	13,536	....	....	13,536	16,523	......	....	....
Total	23,093,792	1,367,494	375,742	1,075	24,838,103	31,932,327	1.29	194	41,986

[a] Morgan, Scioto, and Washington.

The production by counties during the last three years, with the increases and decreases in 1903 as compared with 1902, is shown in the following tables:

Coal production of Ohio, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Athens	1,786,041	2,283,520	2,968,720	3,319,597	3,424,958	105,361	....
Belmont	1,242,388	1,345,284	1,506,858	1,997,956	2,725,849	727,893	....
Carroll	227,191	167,521	180,773	225,379	254,440	29,061	....
Columbiana	885,179	692,264	734,680	793,858	907,325	113,467	....
Coshocton	392,373	353,314	413,579	437,784	454,008	16,224	....
Gallia	13,536	15,620	14,826	21,470	48,948	27,478	....
Guernsey	1,562,986	1,852,327	2,287,870	2,655,610	2,776,829	121,219	....
Harrison	1,390	6,342	79,692	361,492	259,047	....	102,445
Hocking	2,018,865	2,518,605	2,768,772	2,641,141	2,506,410	....	134,731
Holmes	....	....	....	14,785	41,338	26,553	....
Jackson	2,032,233	2,304,892	2,175,316	2,412,509	2,411,145	....	1,364
Jefferson	924,214	1,110,586	1,322,305	1,812,801	2,479,211	666,410	....
Lawrence	116,972	95,425	107,216	183,369	228,251	44,882	....
Mahoning	43,906	46,462	109,349	127,747	123,206	....	4,541
Medina	191,351	129,913	108,684	90,718	132,823	42,105	....
Meigs	273,730	242,275	237,614	339,639	316,888	....	22,751
Morgan	24,905	24,004	27,276	86,821	93,675	6,854	....
Muskingum	142,645	184,274	137,670	225,413	281,649	56,236	....
Perry	1,735,487	2,364,791	2,446,872	2,743,997	2,731,282	....	12,715
Portage	106,008	101,240	150,678	100,266	109,794	9,528	....
Stark	1,079,228	1,116,524	896,996	1,080,429	910,865	....	169,564
Summit	68,702	109,855	106,988	67,442	42,118	....	25,324
Trumbull	7,575	14,099	8,506	12,030	10,652	....	1,378
Tuscarawas	979,431	1,260,588	1,510,462	1,578,610	1,279,636	....	298,974
Vinton	71,839	68,901	46,880	92,441	192,069	99,628	....
Washington	8,322	5,300	3,010	3,604	3,600	....	4
Wayne	13,754	16,357	27,540	78,390	69,870	....	8,520
Noble, Scioto	[a] 48,024	58,367	64,675	14,596	[b] 8,681	....	5,915
Small mines	500,000	500,000	500,000	([c])	13,536	13,536	....
Total	16,500,270	18,988,150	20,943,807	23,519,894	24,838,103	[d] 1,318,209	....

[a] Includes Geauga County.
[b] No production in Noble County.
[c] Small mines production included in county distribution.
[d] Net increase.

Statistics as to the distribution of the coal product for consumption have been obtained only since 1889. Since that date the quantity and value of the product, the average price per ton each year, and the number of men employed are shown in the following table:

Distribution of the coal product of Ohio, 1889–1903.

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
1903..........	23,093,792	1,367,494	375,742	1,075	24,838,103	31,932,327	1.29	194	41,986

So far as statistics are available, the first production of coal in Ohio was made in 1838, when an output of 119,952 tons was reported. The census of 1840 reported a production for that year of 140,536 tons. From 1838 to the close of 1903 the total production of the State amounted, approximately, to 383,000,000 tons, the production for each year being shown in the following table. From 1840 to 1863 the production of each year has been estimated from the best information obtainable, official statistics not being available.

Annual coal production of Ohio, 1838–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1838	119,952	1871	4,000,000
1839	125,000	1872	5,315,294
1840	140,536	1873	4,550,028
1841	160,000	1874	3,267,585
1842	225,000	1875	4,864,259
1843	280,000	1876	3,500,000
1844	340,000	1877	5,250,000
1845	390,000	1878	5,500,000
1846	420,000	1879	6,000,000
1847	480,000	1880 [a]	6,008,595
1848	540,000	1881	9,240,000
1849	600,000	1882	9,450,000
1850	640,000	1883	8,229,429
1851	670,000	1884	7,640,062
1852	700,000	1885	7,816,179
1853	760,000	1886	8,435,211
1854	800,000	1887	10,300,708
1855	890,000	1888	10,910,951
1856	930,000	1889	9,976,787
1857	975,000	1890	11,494,506
1858	1,000,000	1891	12,868,683
1859	1,060,000	1892	13,562,927
1860 [a]	1,265,600	1893	13,253,646
1861	1,150,000	1894	11,909,856
1862	1,200,000	1895	13,355,806
1863	1,204,581	1896	12,875,202
1864	1,815,622	1897	12,196,942
1865	1,536,218	1898	14,516,867
1866	1,887,424	1899	16,500,270
1867	2,092,334	1900	18,988,150
1868	2,475,844	1901	20,943,807
1869	2,461,986	1902	23,519,894
1870 [a]	2,527,285	1903	24,838,103

[a] United States census, fiscal year.

OREGON.

Total production in 1903, 91,144 short tons; spot value, $221,031.

Compared with 1902, the production of Oregon in 1903 shows an increase of 25,496 short tons, or 38.8 per cent, in quantity, and of $60,956, or 38.1 per cent, in value. The increased production is due in large part to the reopening of the Beaver Hill mine in Coos County. The entire production of the State is lignite, and most of the product is shipped to San Francisco by water.

In the following tables are shown the statistics of the production for the last twelve years, and the total output since 1880:

Distribution of the coal product in Oregon, 1892–1903.

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
1903	67,192	9,848	14,104	91,144	221,031	235	256

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, 1880–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1880	a 43,205	1892	34,661
1881	33,600	1893	41,683
1882	35,000	1894	47,521
1883	40,000	1895	73,685
1884	45,000	1896	101,721
1885	50,000	1897	107,289
1886	45,000	1898	58,184
1887	37,696	1899	86,888
1888	75,000	1900	58,864
1889	64,859	1901	69,011
1890	61,514	1902	65,648
1891	51,826	1903	91,144

a United States census, fiscal year.

PENNSYLVANIA.

Total production in 1903, 158,682,363 long tons, or 177,724,246 short tons; spot value, $273,789,207.

Anthracite.—Total production in 1903, 66,613,454 long tons; spot value, $152,036,448.

Bituminous.—Total production in 1903, 103,117,178 short tons; spot value, $121,752,759.

Owing to the great strike in the anthracite region in Pennsylvania in 1902 the production in that year was entirely suspended for a period of five months, and the tonnage, as compared with 1901, showed a decrease of 23,301,850 long tons, or 38.7 per cent. The settlement of the strike by the appointment of a Commission by the President of the United States carried with it an agreement on the part of the operators and the United Mine Workers of America to abide by the decision of the Commission for a period of three years, and to refer any matters of controversy to a board of conciliation recommended by the Commission during this period. In consequence of this settlement the anthracite region was practically free from labor disturbances during 1903, and the mines were worked at a rate previously unknown in the history of the industry. During the continuance of the strike all available supplies of anthracite coal had disappeared, so that when mining was resumed demands for the replenishment of these, as well as the demands caused by an unusually cold winter in 1902 and 1903, created an unprecedented activity in the anthracite industry resulting in the largest production in its history. Notwithstanding, however, that the output in 1903 showed a gain of nearly 30,000,000 long tons over 1902, the average production for the last two years was nearly 8,000,000 tons less than the production of 1901. The production of 1901, however, was exceptionally large following the decreased production in 1900, which was in turn due to a strike of the mine workers in that year. The average production for the last three years, notwithstanding the greatly reduced output in 1902, amounted to 54,598,908 long tons, or about 650,000 tons more than the production of 1899, in which the largest output was obtained prior to 1901.

The production of bituminous coal in Pennsylvania amounted in 1903 to 103,117,178 short tons, exceeding for the first time a total of 100,000,000, and showing an increase over 1902 of 4,542,811 short tons, or 4.6 per cent, in quantity, and of $15,720,299, or 14.8 per cent, in value.

Attention has been called in previous reports to the comparative gain which the production of bituminous coal has made over that of anthracite. The following table has been prepared showing the average production of Pennsylvania anthracite and of bituminous coal for the fifteen years from 1876 to 1900, inclusive, and for the three years 1901–1903. This table shows that in the last five years of the period production of the anthracite was something over double that of the first five years, while the bituminous production increased nearly five times. On account of the decreased production of anthracite in 1902 the comparison from 1901 to the close of 1903 can not be considered as fairly representing the conditions. The statistics show, however, that while the average production of anthracite in these last three years was 61,150,777 short tons, the average production of bituminous coal was 256,264,780 tons, or more than four times that of anthracite, and that in the five years from 1876 to 1880 the average production of bituminous coal was only 36 per cent more than that of anthracite.

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
1901–1903 (3 years)	61,150,777	256,264,780

Until 1902 Pennsylvania enjoyed the distinction of producing more than one-half of the entire coal output of the United States. The shortage produced by the anthracite strike reduced the percentage of Pennsylvania to a total, in 1902, of 46 per cent. Notwithstanding the increased production in 1903, the tonnage of the State in the latter year was still slightly less than half of the total for the United States. In 1880 Pennsylvania produced 66 per cent of the entire output of the United States, and while the percentage has showed a decreasing tendency since that time the average for the last twenty-four years has been nearly 55 per cent of the total. Pennsylvania alone produces more coal than any other country in the world, with the exception of Great Britain and Germany, and exceeds the combined production of Austria, France, and Belgium, which rank, respectively, as fourth, fifth, and sixth among the coal-producing countries of the world. The following table shows the total production of Pennsylvania and of the United States since 1880, with the percentage of the tonnage produced by Pennsylvania in each year:

Production of Pennsylvania coal compared with total United States, 1880–1903.

Year.	Total United States.	Pennsylvania.	Per cent of Pennsylvania to total.
	Short tons.	*Short tons.*	
1880	71,481,569	47,529,711	66
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
1903	357,356,416	177,724,246	50

The production of anthracite and bituminous coal in Pennsylvania is discussed separately in the following pages. The chapter on anthracite has been prepared for this report, as for several years previously, by Mr. William W. Ruley, Chief of the Bureau of Anthracite Coal Statistics, Philadelphia, Pa. Mr. Ruley is thoroughly conversant with the statistics and with the conditions affecting the industry, and his statements are accepted as official and authoritative. One of the interesting features of his report in the last two years has been the discussion of the increased consumption of small sizes of anthracite in competition with the larger and more profitable sizes, and of the recovery of usable fuel from the old culm banks by means of washeries.

PENNSYLVANIA ANTHRACITE.

By William W. Ruley.

The year 1903 stands as the high-water mark of prosperity in the anthracite trade, the tonnage for 1903 having exceeded by over 6,000,000 long tons that of any previous year, and the demand for coal being so good as to make it possible to dispose of the product at prices which brought a fair return to all concerned in the industry.

To those familiar with the trade it is hardly necessary to comment on the conditions which made it possible to produce and market such a large quantity of coal. At the commencement of the year there was practically no anthracite in stock, the coal which had been mined after the strike of 1902 having gone directly into consumption, with the demand very largely in excess of the capacity of the producing companies to supply it, so that the year 1903 started under the most favorable conditions for the sale of anthracite coal, and all that could be mined during the first three months was in immediate demand.

With the opening of navigation and a reduction in price made April 1, dealers at all points endeavored to lay in an ample supply to meet their fall and winter requirements. This made a brisk demand for the product during the spring and summer months, with the resulting accumulation of stocks in dealers' hands. However, the early coming of cold weather and its continued severity during the entire winter caused a very large consumption of coal; indeed, in many places remote from the source of supply and where railroad facilities were deranged on account of the cold and the snowstorms, there was absolutely no anthracite to be obtained. It was unfortunate that there were not more ample supplies at these places, as a demand of this kind is, of course, one which must be met immediately or not at all.

In connection with the large production it is interesting to note the increase in the shipments of the small sizes of coal in 1903 over previous years. This will be seen from the following table, which gives the shipments for sizes above pea and for pea and smaller sizes for the last three years:

Shipments of anthracite according to larger and smaller sizes in 1901, 1902, and 1903.

[Long tons.]

Year.	Sizes above pea.		Pea and smaller sizes.		Total shipments.
	Quantity.	Per cent.	Quantity.	Per cent.	Quantity.
1901	34,412,974	64.25	19,155,627	35.75	53,568,601
1902	19,025,632	60.98	12,175,258	39.02	31,200,890
1903	37,738,510	63.57	21,624,321	36.43	59,362,831

This is especially noteworthy on account of the generally expressed opinion at the close of the anthracite strike that bituminous coal had very largely taken the place of anthracite for steam purposes, and would continue to hold this trade to the exclusion of the small sizes of the latter product. On the contrary, however, the consumption of these smaller sizes of coal increased 2,468,694 tons in 1903 over 1901.

The probable explanation of this is that although anthracite did not regain all its old trade, it did gain new trade along various lines where its use is advantageous and where it can continue to hold its own in competition with bituminous coal. This is an illustration of the difficulty of attempting to foretell very far in advance the conditions which will prevail in any large industry subjected to so many and to such varying influences. It would seem that the only cause which would seriously affect the prosperity of the anthracite business is the general condition of the entire country—in short, the ability of the people at large to buy it.

In connection with the large production it is of interest to note an increase of 15 cents in the average value per ton for coal at mines. The total production and the total value of the product for the last three years, together with the average number of days worked and the average number of men employed, are shown in the following table:

Statistics of production of anthracite, 1901–1903.

Year.	Quantity.	Value of coal sold.	Average price per ton.	Average number of men employed.	Average number of days worked.
	Long tons.				
1901	60,242,560	$112,504,020	$2.05	145,309	196
1902	36,940,710	76,173,586	2.35	148,141	116
1903	66,613,454	152,036,448	2.50	150,483	206

In considering this table it should be borne in mind that the coal used for steam and heat at the mines, amounting to 5,786,407 tons, is not taken into consideration in the valuation, as this is largely culm and dirt.

The following tables show the production by counties for the years 1902 and 1903:

Anthracite production in 1902, by counties.

[Long tons.]

County.	Shipments.	Local trade.	Steam and heat.	Total.
Susquehanna	373,451	9,792	21,005	404,248
Lackawanna	9,659,014	269,678	850,576	10,779,268
Luzerne	11,040,374	377,379	1,435,073	12,852,826
Carbon	796,791	24,621	164,789	986,201
Schuylkill	6,240,258	193,278	1,270,666	7,704,202
Columbia	588,058	11,323	70,734	670,115
Sullivan	285,230	2,982	7,788	296,000
Northumberland	2,308,253	92,719	477,643	2,878,615
Dauphin	194,691	13,883	160,661	369,235
Total	31,486,120	995,655	4,458,935	36,940,710

Anthracite production in 1903, by counties.

[Long tons.]

County.	Shipments.	Local trade.	Steam and heat.	Total.
Susquehanna	670,467	8,936	35,571	714,974
Lackawanna	16,459,302	359,154	1,012,125	17,830,581
Luzerne	22,377,088	540,324	2,060,283	24,977,695
Carbon	1,647,522	24,839	206,809	1,879,170
Schuylkill	12,380,127	157,306	1,681,621	14,219,054
Columbia	1,103,615	13,874	91,355	1,208,844
Sullivan	246,626	2,647	12,468	261,741
Northumberland	4,253,233	80,488	511,610	4,845,331
Dauphin	471,477	17,554	187,033	676,064
Total	59,609,457	1,205,122	5,798,875	66,613,454

In connection with the above tables, the statement below is given in order to show the proportion of the various sizes shipped to market during the years 1901, 1902, and 1903:

Shipments of anthracite according to sizes in 1901, 1902, and 1903.

[Long tons.]

Size.	1901.		1902.		1903.	
	Quantity.	Per cent.	Quantity.	Per cent.	Quantity.	Per cent.
Lump	2,187,553	4.08	1,227,114	3.93	2,208,116	3.71
Broken	4,423,584	8.26	2,548,930	8.17	4,825,497	8.13
Egg	6,989,330	13.05	3,880,404	12.44	7,917,689	13.34
Stove	10,561,957	19.72	5,757,713	18.45	11,591,573	19.52
Chestnut	10,250,550	19.14	5,611,471	17.99	11,200,635	18.87
Pea	7,555,948	14.11	4,162,913	13.34	7,929,715	13.36
Buckwheat No. 1	7,894,613	14.72	4,419,775	14.17	8,180,880	13.78
Smaller than Buckwheat No. 1	3,705,066	6.92	3,592,570	11.51	5,513,726	9.29
Total	53,568,601	100.00	31,200,890	100.00	59,362,831	100.00

Of the above shipments a considerable portion is washery coal, this being reclaimed from the culm banks. The following table shows the amount of this product from the time it became an item of trade up to the present:

Shipments of anthracite coal from washeries compared with total shipments, 1890–1903.

Year.	Shipments from washeries.	Total shipments.	Per cent of washery output to total shipments.
	Long tons.	*Long tons.*	
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
1903	3,693,606	59,362,831	6.22

In order to continue the record of the anthracite business from the earliest date to the present time the following table shows the shipments of coal from each region from 1820 to 1903, inclusive. It should be noted that these shipments include only coal loaded on cars for line or tide-water points, and do not include any coal sold locally or used under the boilers at the mines.

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1903.

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.*
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

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1903—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.*
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
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

[a] Includes Loyalsock field.

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1903—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.*
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
1903	16,474,790	27.75	7,164,783	12.07	35,723,258	60.18	59,362,831
Total	434,419,139	33.00	219,204,337	16.66	662,521,514	50.34	1,316,144,990

a Includes Loyalsock field.

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:

Geological field or basin.	Local district.	Trade region.
Northern	Carbondale	Wyoming.
	Scranton	
	Pittston	
	Wilkesbarre	
	Plymouth	
	Kingston	
Eastern Middle	Green Mountain	Lehigh.
	Black Creek	
	Hazelton	
	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, Lackawanna, Luzerne, Northumberland, Schuylkill, and Susquehanna, and are classed under three general divisions, viz, Wyoming, Lehigh, and Schuylkill regions. Geologically they are divided into fields or basins, which are again 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 tonnage from this field is not included in the shipments by regions nor in the division of shipments according to sizes.

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.

PENNSYLVANIA BITUMINOUS COAL.

Total production in 1903, 103,117,178 short tons; spot value, $121,-752,759.

The increase in the production of bituminous coal in Pennsylvania, which was mentioned in the report for 1902 as having taken place, annually since 1896, continued in 1903, though in somewhat less proportions. Compared with 1902 the production of bituminous coal in Pennsylvania in 1903 increased 4,542,811 short tons, or 4.6 per cent, compared with an increase of 16,268,421 short tons, or 19.8 per cent, in 1902 over 1901. The increase in value in 1903 amounted to $15,720,299, or 14.8 per cent, as compared with $24,634,874, or 30.3 per cent, in 1902 over 1901. The average price per ton at the mines, which has shown an increasing tendency since 1898, reached its high-water mark in 1903 with an average of $1.18, the highest price recorded in many years. In 1898 the average price for Pennsylvania coal was $0.67 at the mines. The total advance in price in five years amounted to $0.51, or a little over 75 per cent.

Of the total production of bituminous coal in Pennsylvania in 1903, 37,146,253 tons, or 36.02 per cent were undercut by the use of mining machines. In 1902, 35,058,038 tons, or 35.57 per cent, were machine-mined, while in 1901, 29,591,368 tons, or 35.95 per cent, were machine mined. The number of machines in use increased from 2,058 in 1901 to 2,620 in 1902 and to 3,310 in 1903. Of the machines in use in 1903 2,267 were of the pick or "puncher" type, 1,039 were of the chain breast style, and 4 were long wall.

The returns for 1903 show that there was considerable falling off in the average production per man both for the year and for each day's work. The number of men employed in the bituminous coal mines of Pennsylvania last year was 129,265, who produced 103,117,178 short tons during the year, or 797.7 tons per man. As they worked an average of 235 days, the average tonnage per man per day amounted to 3.40. In 1902, 112,630 men worked an average of 248 days and produced an average of 875 tons each for the year and 3.52 per day. In 1901 the average daily tonnage per man was 3.53, and the average production per man for the year 808 short tons. During 1903 the average working time per day was nine hours. Considering the importance of the bituminous coal mining industry of Pennsylvania, the time lost by reason of strikes, both in 1903 and 1902, was of an insignificant character. During the year 1903 there were at different times 12,805 men idle by reason of strikes; the total time lost was 321,925 working days, or an average of 25 days for each man on strike. This is a slight increase over 1902, when there were, altogether, 12,580 men on strike, with a total loss in working time of 264,862 days, or an average of 21 days each. The total time lost by strikes in 1903 was a little more than 1 per cent of the total time worked, so that the industry can not be said to have been affected materially by strikes. Details of the bituminous coal production in Pennsylvania during the last two years, by counties, are shown in the following tables:

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 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	$12,839,715	$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	378,437	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	1,438	....	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	18,990,437	1.00	278	15,789

Bituminous coal production of Pennsylvania 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 year.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
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	673,456	1.07	266	988
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	106,082,460	1.08	248	112,680

[a] Clinton, Greene, and Lycoming.

Bituminous coal production of Pennsylvania in 1903, 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 year.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Allegheny	12,085,309	420,858	183,058	....	12,689,225	$15,505,863	$1.22	226	17,108
Armstrong	1,849,074	31,371	40,139	....	1,920,584	2,152,510	1.12	283	3,105
Beaver	165,954	12,808	1,340	....	180,102	262,140	1.46	239	477
Bedford	762,808	6,506	8,611	148,410	926,334	1,216,398	1.31	221	1,666
Blair	164,628	5,639	7,638	131,881	309,786	459,582	1.48	196	528
Butler	599,152	35,880	14,001	....	649,033	816,878	1.26	212	1,298
Cambria	9,553,107	233,326	209,880	946,183	10,942,496	13,698,752	1.25	228	16,392
Center	692,658	47,692	1,355	17,753	759,458	781,129	1.03	155	1,313
Clarion	519,451	3,586	8,593	....	531,630	634,679	1.19	223	1,275
Clearfield	6,982,386	87,509	100,949	291,838	7,462,682	8,233,181	1.10	234	10,883
Elk	1,215,950	34,543	25,325	63,463	1,339,281	1,447,418	1.08	246	2,330
Fayette	7,211,202	188,704	444,752	11,768,503	19,613,161	22,175,840	1.13	252	17,244
Huntingdon	479,467	10,709	9,300	1,171	500,647	687,836	1.37	225	896
Indiana	1,739,897	66,285	42,937	194,021	2,043,140	2,272,477	1.11	244	3,036
Jefferson	5,109,915	17,527	33,157	1,314,165	6,474,764	6,688,694	1.03	263	7,022
Lawrence	205,995	13,715	13,282	....	232,992	322,361	1.38	227	550
Mercer	668,972	8,202	27,573	....	704,747	920,566	1.31	248	1,196
Somerset	5,743,922	16,935	122,678	74,216	5,957,751	7,844,318	1.32	230	8,150
Tioga	868,744	29,802	7,142	....	905,688	1,495,956	1.65	181	2,281
Washington	8,960,741	94,969	156,623	3,934	9,216,267	10,591,514	1.15	214	10,855
Westmorland	11,801,417	196,856	399,258	6,730,373	19,127,904	22,627,418	1.18	253	20,683
Other counties [a]	606,602	2,224	5,772	8,447	623,045	914,056	1.47	254	961
Small mines	....	6,511	....	....	6,511	8,201	......	......	....
Total	77,987,351	1,572,156	1,863,363	21,694,308	108,117,178	121,752,759	1.18	235	129,265

[a] Cameron, Clinton, Greene, Lycoming.

In the following table is shown the total production by counties during the last five years, with the increases and decreases in 1903 as compared with 1902, and it will be observed that out of the twenty-five counties in which coal was produced in 1903 there were only five in which the production decreased:

Bituminous coal production of Pennsylvania, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Allegheny	9,972,060	10,051,905	10,307,100	11,919,569	12,689,225	769,656	....
Armstrong	1,054,889	1,313,188	1,555,255	1,793,179	1,920,584	127,405	....
Beaver	258,466	262,398	176,012	225,162	180,102	....	45,060
Bedford	493,965	570,055	500,322	797,248	926,334	129,086	....
Blair	407,356	496,992	368,779	338,204	309,736	....	28,468
Bradford	31,835	32,065	22,189	....	....	....	....
Butler	214,899	221,704	269,161	454,166	649,033	194,867	....
Cambria	7,208,884	8,190,866	9,045,201	10,561,835	10,942,496	380,661	....
Center	912,648	932,265	839,512	1,000,598	759,458	....	241,140
Clarion	289,753	404,689	354,840	458,221	531,630	73,409	....
Clearfield	6,251,442	6,620,884	5,886,407	7,334,785	7,462,682	127,897	....
Clinton	221,574	288,881	306,228	365,732	403,543	37,811	....
Elk	1,221,979	926,408	1,007,314	756,182	1,339,281	583,099	....
Fayette	14,609,289	15,055,242	16,187,224	18,988,058	19,613,161	625,103	....
Greene	....	....	....	25,550	153,000	127,450	....
Huntingdon	357,812	368,942	374,529	460,485	500,647	40,162	....
Indiana	616,911	924,782	1,074,260	1,655,281	2,043,140	387,859	....
Jefferson	5,841,960	6,199,290	5,806,568	6,083,494	6,474,764	391,270	....
Lawrence	183,555	187,810	171,959	212,445	232,992	20,547	....
Lycoming	101,923	99,000	107,095	112,820	57,030	....	55,790
McKean	23,708	20,214	....	....	....	....	....
Mercer	486,724	528,070	577,338	628,713	704,747	76,034	....
Somerset	2,960,343	4,779,307	4,831,660	5,911,326	5,957,751	46,425	....
Tioga	670,126	931,301	861,072	1,149,849	905,688	....	244,161
Washington	4,987,860	4,856,138	5,910,621	8,529,954	9,216,267	686,313	....
Westmoreland	14,181,269	14,980,585	15,165,300	18,811,511	19,127,904	316,393	....
Small mines	600,000	600,000	600,000	(a)	b 15,983	15,983	....
Total	74,150,175	79,842,326	82,305,946	98,574,367	103,117,178	c 4,542,811	....

a Small mines production included in county distribution.
b Includes production of Cameron County.
c Net increase.

The distribution of the product for consumption during the last fifteen years has been as follows:

Distribution of the bituminous coal product of Pennsylvania, 1889–1903.

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......	29,722,808	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......	60,165,817	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
1903......	77,987,351	1,572,156	1,863,363	21,694,308	103,117,178	121,752,759	1.18	235	129,265

The statistics of the early production of bituminous coal in Pennsylvania, particularly as compared with the anthracite records, are sadly wanting. The United States Census of 1840 shows a production of bituminous coal in the State of 464,826 short tons. The Census of 1860 reports a production of 2,690,786 short tons; that of 1870 shows a production of 7,798,518 short tons. The production for the intervening years, as shown in the following tables, has been estimated from the best information obtainable. Since 1871 the records are official. The total production of bituminous coal as shown by the following table amounted to 1,350,280,946 short tons. The anthracite production from 1814 to the close of 1903 amounted to 1,623,807,039 short tons, showing that the total production of the State has been nearly evenly divided between the two periods.

Production of bituminous coal in Pennsylvania, 1840–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1840 a	464,826	1872	11,695,040
1841	475,000	1873	13,098,829
1842	500,000	1874	12,320,000
1843	650,000	1875	11,760,000
1844	675,000	1876	12,880,000
1845	700,000	1877	14,000,000
1846	760,000	1878	15,120,000
1847	399,840	1879	16,240,000
1848	500,000	1880 a	18,425,163
1849	750,000	1881	22,400,000
1850	1,000,000	1882	24,640,000
1851	1,200,000	1883	26,880,000
1852	1,400,000	1884	28,000,000
1853	1,500,000	1885	26,000,000
1854	1,650,000	1886	27,094,501
1855	1,780,000	1887	31,516,856
1856	1,850,000	1888	33,796,727
1857	2,000,000	1889	36,174,089
1858	2,200,000	1890	42,302,173
1859	2,400,000	1891	42,788,490
1860 a	2,690,786	1892	46,694,576
1861	3,200,000	1893	44,070,724
1862	4,000,000	1894	39,912,463
1863	5,000,000	1895	50,217,228
1864	5,839,000	1896	49,557,453
1865	6,350,000	1897	54,417,974
1866	6,800,000	1898	65,165,133
1867	7,300,000	1899	74,150,175
1868	7,500,000	1900	79,842,326
1869	6,750,000	1901	82,305,946
1870 a	7,798,518	1902	98,574,367
1871	9,040,565	1903	103,117,178

a United States census, fiscal year.

TENNESSEE.

Total production in 1903, 4,798,004 short tons; spot value, $5,979,830.

Compared with 1902 the total production of Tennessee in 1903 shows an increase of 415,036 short tons, or 9.5 per cent in quantity, and of $580,109, or 10.7 per cent in value. For a period of ten years, or since 1893, the total production of Tennessee has increased each year, the output in 1903 being two and one-half times that of 1893. The value increased in much greater proportion, the amount received for the product in 1903 being nearly three times that of 1893. The average price per ton in 1903 was $1.25, which is the highest obtained in any year since the statistics of the amount and value of the coal production of the State has been collected.

The use of mining machines does not show any material gain so far as the production is concerned over 1902, although there was an increase from 38 to 51 in the number of machines in use. The machine-mined product in 1903 amounted to 304,602 short tons, as compared with 303,995 short tons in 1902. There was a slight decrease in the productive efficiency in 1903, as shown by the fact that in that year 9,961 men produced a total of 4,798,004 short tons, an average of 482 tons per man for the year, and as the average working time is 227 days, the production per man per day amounted to 2.12. In 1902, 8,750 men were employed for an average of 230 days with a production of 4,382,968 tons, an average of 501 tons per man per year and 2.18 tons per man per day. In 1901 the average production per man was 401.7 tons for the year and 1.76 tons per day.

During 1903 there were comparatively few strikes in the State. The total number of men idle at any time by reason of labor troubles was 1,639; the average time lost was 22 days for each man, or a total of 36,021 working days. The average length of working days in 1903 was nine hours. The details of production by counties during the last two years are shown in the following tables:

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.

Coal production of Tennessee in 1903, 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	644,095	4,267	7,359	....	655,721	$837,088	$1.28	207	1,341
Campbell	515,208	23,067	16,069	146,024	700,368	929,551	1.33	202	1,612
Claiborne	737,237	6,700	6,314	34,377	784,628	844,863	1.08	242	1,150
Cumberland	101,084	558	2,068	30,388	134,098	147,954	1.10	244	208
Grundy	366,256	2,149	1,135	97,102	466,642	577,976	1.24	250	725
Marion	328,119	5,260	4,719	101,686	439,784	644,796	1.47	241	959
Morgan	410,972	3,482	6,281	103,750	524,485	667,857	1.27	208	1,438
Overton	82,100	340	900	....	83,340	102,440	1.23	242	158
Rhea	77,071	6,793	3,660	144,165	231,689	259,004	1.12	220	470
Scott	115,930	5,180	3,314	18,000	142,424	159,243	1.12	213	385
Other counties[a]	385,356	8,198	13,552	226,330	633,436	806,811	1.27	260	1,520
Small mines	....	1,894	....	....	1,894	2,747	......	....	....
Total	3,763,428	67,388	65,371	901,817	4,798,004	5,979,830	1.25	227	9,961

[a] Bledsoe, Franklin, Hamilton, Roane, Sequatchie, and White.

In the following table is shown the total production of the State by counties during the last five years, with the increases and decreases in 1903 as compared with 1902:

Coal production of Tennessee, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Anderson	637,214	672,752	664,409	759,276	655,721	....	103,555
Campbell	429,717	502,991	570,348	654,165	700,368	46,203	....
Claiborne	387,499	392,699	451,590	748,765	784,628	35,863	....
Cumberland	1,060	88	55,327	109,582	134,093	24,511	....
Grundy	305,736	300,198	326,990	332,550	466,642	134,092	....
Hamilton	199,230	227,063	242,998	250,526	264,268	13,742	....
Marion	339,866	310,730	307,609	312,446	439,784	127,338	....
Morgan	350,336	388,142	367,004	469,642	524,485	54,843	....
Overton	....	....	....	....	83,340	83,340	....
Putnam	8,586	7,275	3,648	....	....	....	....
Rhea	181,428	210,528	183,005	239,697	231,689	....	8,008
Roane	162,441	181,758	159,221	152,947	129,480	....	23,467
Scott	157,256	100,838	102,654	98,529	142,424	43,895	....
White	166,270	210,505	192,226	182,501	167,900	....	14,601
Other counties and small mines	4,500	4,500	6,271	72,342	73,182	840	....
Total	3,330,659	3,509,562	3,633,290	4,382,968	4,798,004	564,667	149,631
Net increase	307,763	178,903	123,728	749,678	415,036	....	....

The distribution of the product for consumption since 1889 has been as follows:

Distribution of the coal product of Tennessee, 1889–1903.

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	23,084	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	17,087	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	28,998	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	6,581
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
1903	3,763,428	67,388	65,371	901,817	4,798,004	5,979,830	1.25	227	9,961

The United States census for 1840 reports the production of coal in Tennessee as 558 tons. There are no statistics of any production between 1840 and 1860; the census for those years reported an output of 558 short tons and 165,300 short tons, respectively. The census for 1870 reported a production of 133,418 tons. The production for the intervening years, for which no official records are obtainable, have been estimated by the writer.

Coal production of Tennessee, 1840, 1860–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1840	a 558	1873	350,000
1860 a	165,300	1874	850,000
1861	150,000	1875	360,000
1862	140,000	1876	550,000
1863	100,000	1877	450,000
1864	100,000	1878	375,000
1865	100,000	1879	450,000
1866	100,000	1880 a	495,131
1867	110,000	1881	840,000
1868	125,000	1882	850,000
1869	130,000	1883	1,000,000
1870 a	133,418	1884	1,200,000
1871	180,000	1885	1,440,957
1872	224,000	1886	1,714,290

a United States census, fiscal year.

Coal production of Tennessee, 1840, 1860–1903—Continued.

Year.	Quantity.	Year.	Quantity.
1887	1,900,000	1896	2,663,106
1888	1,967,297	1897	2,888,849
1889	1,925,689	1898	3,022,896
1890	2,169,585	1899	3,330,659
1891	2,413,678	1900	3,509,562
1892	2,092,064	1901	3,633,290
1893	1,902,258	1902	4,382,968
1894	2,180,879	1903	4,798,004
1895	2,535,644		

TEXAS.

Total production in 1903, 926,759 short tons; spot value, $1,505,383.

The large increase in the production of fuel oil in Texas in 1902 and 1903 was naturally felt adversely by the coal mining industry of the State. This was particularly true in 1902, when the production fell off to 901,902 short tons from a production of 1,107,953 tons in 1901. The production of coal increased slightly in 1903, but was still more than 180,000 tons short of the banner year 1901 and over 40,000 tons less than that of 1900. The increased production in 1903 over 1902 may be attributed to the fact that the wild character of the exploitation in the oil fields which was evident in 1901, and which resulted in a production far in excess of any reasonable requirements, has settled down to a more conservative basis. This condition was due principally to the rapid decline of the "gusher" character of the productive wells, which had thrown millions of barrels of fuel oil upon the market at ridiculously low prices. As a result of this enormous production of low-priced oil many consumers changed to this fuel instead of coal. The falling off in the demand for coal was particularly felt by the lignite producers, the production of lignite in the State declining from 303,155 short tons in 1901 to 205,907 tons in 1902, with a decline from 83 cents to 73 cents in the average price. The steadier tone imparted to the oil excitement by the decline of the gusher production was reflected in a somewhat increased demand for lignite fuel, and the production increased to 267,605 tons. The bituminous production of the State, however, fell off from 696,005 tons in 1902 to 659,154 tons in 1903.

There were twelve counties in the State which produced coal in 1903. In seven of these the product is classed as bituminous coal, and in five the output was entirely of lignite character. The seven bituminous-producing counties are Eastland, Erath, Maverick, Palo Pinto, Parker, Webb, and Wise; and the lignite-producing counties were Houston, Medina, Milam, Shelby, and Wood. Small quantities of lignite were produced in Anderson, Bastrop, Raines, and Robertson counties in 1902, but no output was reported from these counties in

1903. Young County produced a small amount of bituminous coal in 1902, but none was reported from this county in 1903. Palo Pinto County, which produced some bituminous coal in 1901 and 1903, was not credited with any production in 1902.

Of the total product in 1903, 29,000 tons were undercut by the use of mining machines, of which there are eight in use in the State. The production by their use has increased slightly each year, but the number of machines has not changed in the last three years.

During 1903 there were 2,380 men employed an average of 242 days, producing 926,759 short tons, an average of 389 tons per man for the year. The average tonnage per day was 1.61. In 1902 there were 2,369 men employed an average of 267 days in the production of 901,912 tons, an average of 381 tons per man for the year, or 1.43 tons per man per day. The productive capacity in the lignite mines is considerably more than in the bituminous fields, as shown by the fact that in 1903 the daily production per man was 3.2 tons, while in the bituminous mines it was 1.3 tons. The average tonnage per man for the year was in the lignite mines 579.2, and in the bituminous mines 343.7.

Statistics of production for the last two years by counties are shown in the following tables:

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	683,345	4,881	7,779	696,005	$1,326,155	$1.91	278	1,963
Webb								
Wise								
Young								
Lignite:								
Anderson								
Bastrop								
Houston								
Medina								
Milam	203,822	710	1,375	205,907	151,090	.73	192	406
Raines								
Robertson								
Shelby								
Wood								
Total	887,167	5,591	9,154	901,912	1,477,245	1.64	267	2,369

Coal production of Texas in 1903, 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								
Palo Pinto	643,541	4,946	10,667	659,154	$1,289,110	$1.96	256	1,918
Parker								
Webb								
Wise								
Lignite:								
Houston								
Medina								
Milam	236,715	29,075	1,815	267,605	216,273	.81	181	462
Shelby								
Wood								
Total	880,256	34,021	12,482	926,759	1,505,383	1.62	242	2,380

The record of distribution since 1889 has been as follows:

Distribution of the coal product of Texas, 1889–1903.

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	1,958
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
1903	880,256	34,021	12,482	926,759	1,505,383	1.62	242	2,380

UTAH.

Total production in 1903, 1,681,409 short tons; spot value, $2,026,038.

The coal production in Utah has increased without any interruption each year since 1896. This increase has been not only uninterrupted but exceptionally rapid, the production having quadrupled in 8 years. In 1896 the coal production in Utah amounted to 418,627 tons, the output then having about doubled during a period of 10 years. In 1903 the output was more than four times that of 1896, the great increase in the last 8 years being due principally to the development of the silver mining industry and the transportation interests for the State. Compared with 1902 the coal production of Utah in 1903 shows an increase of 106,888 short tons, or 6.8 per cent, in quantity, and of $228,584, or 12.7 per cent, in value. The average price per ton showed at the same time an advance from $1.14 to $1.20.

Of the total amount of coal produced in Utah during 1903, 75,000 tons were mined by the use of undercutting machines, as compared with 74,502 tons in 1902. The number of machines in use, 13, was the same in both years.

The average production per man employed in 1901 was 772.6 tons; in 1902 it was 862 tons, and in 1903 it was 873 tons. The average production per man per day has shown a similar increase, being 2.98 tons in 1901, 3.33 tons in 1902, and 3.52 tons in 1903. The mining industry of Utah has been comparatively free from labor troubles during the last two years. There were no strikes reported in 1902, and in 1903 the entire amount of time lost by strikes was 9,800 working days, 350 men being idle for an average of 28 days each. The statistics of production by counties during the last two years are shown in the following tables:

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

Coal production of Utah in 1903, 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	1,243,193	6,826	42,871	307,096	1,599,986	$1,907,616	$1.19	251	1,752
Emery	1,300	6,878	....	....	8,178	9,270	1.13	113	35
Morgan, Sanpete	5,064	2,232	....	....	7,296	12,130	1.66	210	28
Summit, Uinta	52,198	8,523	3,333	....	64,054	94,068	1.47	251	110
Small mines	....	1,895	....	....	1,895	2,954	....	....	....
Total	1,301,755	26,354	46,204	307,096	1,681,409	2,026,038	1.20	248	1,925

The distribution of the product since 1891 and the total output since 1876 are shown in the following tables:

Distribution of the coal product of Utah, 1891–1903.

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	608,479	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	21,581	45,432	230,215	1,574,521	1,797,454	1.14	259	1,826
1903	1,301,755	26,354	46,204	307,096	1,681,409	2,026,038	1.20	248	1,925

Coal production of Utah, 1876–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1876	50,400	1890	318,159
1877	50,400	1891	371,045
1878	67,200	1892	361,013
1879	50,000	1893	413,205
1880	14,748	1894	431,550
1881	52,000	1895	471,836
1882	100,000	1896	418,627
1883	200,000	1897	521,560
1884	200,000	1898	598,709
1885	213,120	1899	786,049
1886	200,000	1900	1,147,027
1887	180,021	1901	1,322,614
1888	258,961	1902	1,574,521
1889	236,651	1903	1,681,409

VIRGINIA.

Total production in 1903, 3,451,307 short tons; spot value, $3,302,149.

So far as history records, the earliest production of bituminous coal in the United States was from the Richmond Basin in Virginia, in which mining began early in the last century. One authority states that 54,000 tons were produced from this district in 1822, and that in 1824 the production amounted to 67,040 tons; that in 1826 it amounted to 88,720 tons: and in 1828, to 100,080 tons. In each of these years the output exceeded that of Pennsylvania anthracite. The production continued to increase until 1832, when it began to decline, and by 1850 it almost ceased. The statistics of the earlier years of production in Virginia are seemingly unreliable. The census of 1840 reports the production for the State at 424,894 tons. No production was reported by the census of 1850, while that of 1860 credits the State with an output of 473,360 tons. The census of 1870 (the State of West Virginia in the meantime having been separated from Virginia) credits the State of Virginia with an output of 61,803 tons, and reports the production from West Virginia at 608,878 tons. The census of 1880, covering the fiscal year ending June 30, reports a production for Virginia of 43,079 tons. It was shortly after this, in 1882, that the construction of the Norfolk and Western Railroad opened up what is known as the famous Pocahontas district, which includes Tazewell County in Virginia, and McDowell and Mercer counties in West Virginia. The standing of Virginia as a coal mining State may be stated to have rebegun with this development. Ten years later, with the construction of the Clinch Valley division of the Norfolk and Western Railroad, the coal fields of Wise County were developed, since which time the coal production of the State has increased with notable rapidity, the production of 1903 being more than five times that of 1892 and more than four times that of 1893. Compared with 1902 the production of the State in 1903 shows an increase of 268,314 short tons, or 8.4 per cent in quantity, while the value of the product increased $758,554, or 29.8 per cent. The average price per ton advanced from 80 cents in 1902 to 96 cents in 1903.

The statistics of the use of mining machines showed a decided decrease in 1903 as compared with 1902 and 1901, particularly in the amount of coal mined by their use. In 1901, 233,275 tons of coal were machine mined; in 1902 it had decreased to 132,709 tons; in 1903 it decreased further to 82,040 tons, the number of machines in use in the three years being 6 in 1901, 11 in 1902, and 10 in 1903. In connection with this it is interesting to note that the average tonnage per year for each man employed has also decreased.

The statistics of labor employed in the coal mines of Virginia show that 5,608 men were employed in 1903 for an average of 267 days, while 3,912 men were employed in 1902 for an average of 293 days. From this it is deduced that the average tonnage per man per year in 1902 was 814 tons, and in 1903, 615.4 tons. The average production per man per day in 1902 was 2.78 tons, and in 1903 2.3 tons. Details of production by counties during the last two years are shown in the following tables:

Coal production of 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.*				
Montgomery ..	7,911	4,875	....	....	12,786	$30,716	$2.40	238	58
Tazewell	538,854	9,282	18,216	162,451	723,753	684,663	.95	286	634
Wise...........	875,267	6,809	17,731	1,522,620	2,422,417	1,782,583	.74	295	3,143
Chesterfield ... } Pulaski........ }	22,587	....	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

Coal production of Virginia in 1903, 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 ..	11,510	7,856	922	....	20,288	$48,179	2.37	137	103
Tazewell	617,438	6,442	13,451	202,864	840,195	883,289	1.05	287	1,040
Wise...........	968,331	15,466	40,886	1,538,602	2,563,285	2,322,855	.90	266	4,371
Chesterfield ... Pulaski........	25,798	189	1,352	....	27,339	47,526	1.74	215	94
Small mines ...	....	200	....	....	200	300	....	....	....
Total	1,623,077	30,153	56,611	1,741,466	3,451,307	3,302,149	.96	267	5,608

The distribution of the product during the last fifteen years, and the total production since 1880, are shown in the following table:

Distribution of the coal product of Virginia, 1889–1903.

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	896
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	869,878	.63	225	2,156
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	218	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	2,358,989	.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
1903.......	1,623,077	30,153	56,611	1,741,466	3,451,307	3,302,149	.96	267	5,608

Coal production of Vivginia, 1880–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1880 [a]	43,079	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	1903	3,451,307

[a] United States census, fiscal year.

WASHINGTON.

Total production in 1903, 3,193,273 short tons; spot value, $5,380,679.

Washington is the only one of the Pacific Coast States producing true coal, all of the product from California and from Oregon being lignitic in character. Some of the Washington coals have the characteristics of anthracite, some are true coking coals, and some natural coke has been produced. The production in the State has increased regularly since 1894, and the increase in 1903 over the preceding year was particularly noticeable. This increase amounted to 512,059 short tons, or 19.1 per cent in quantity, and $808,384, or 17.7 per cent in value. The production has more than doubled since 1897, and more than trebled since 1891.

The use of mining machines has not been successful in Washington. Two were in use there in 1899 and 1900 and four in 1901. Conditions were not found favorable to their continuance and their use has been abandoned, no production by machines having been reported there in 1902 or 1903.

The statistics of labor employed in the coal mines of Washington show that in 1902 the average production per man was 609 short tons, and in 1903, 670 short tons, the average tonnage per day per man also increasing from 2.22 tons in 1902 to 2.35 tons in 1003. The details of production by counties during the last two years are shown in the following tables:

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.

Coal production of Washington in 1903, 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	1,155,693	21,325	52,542	....	1,229,560	$2,134,421	$1.74	275	2,008
Kittitas	1,338,160	12,841	18,715	....	1,369,716	1,948,263	1.42	296	1,630
Pierce	473,151	3,065	21,419	75,165	572,800	1,258,230	2.20	287	1,035
Lewis, Skagit, and Whatcom	11,815	1,310	8,072	....	21,197	39,765	1.88	251	100
Total	2,978,819	38,541	100,748	75,165	3,193,273	5,380,679	1.69	285	4,763

The total production by counties for the last five years, with the increases and decreases in 1903 as compared with 1902, is shown in the following table:

Production of coal in Washington, 1899–1903, by counties.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Cowlitz	480	500	....	....	....	....	....
King	847,308	1,003,101	957,549	1,017,888	1,229,560	211,672	....
Kittitas	661,210	873,751	1,012,521	1,250,920	1,369,716	118,796	....
Lewis	300	300	520	826	1,410	584	....
Pierce	506,385	577,127	585,984	383,603	572,800	189,197	....
Skagit	6,755	10,130	12,643	21,967	19,115	....	2,852
Whatcom	7,448	9,184	9,000	6,010	672	....	5,338
Total	2,029,881	2,474,093	2,578,217	2,681,214	3,193,273	*a* 512,059	....

a Net increase.

The distribution of the product during the last fifteen years has been as follows:

Distribution of the coal product of Washington, 1889–1903.

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
1903	2,978,819	38,541	100,748	75,165	3,193,273	5,380,679	1.69	285	4,768

The United States Census report of 1860 states that in that year the coal production of Washington amounted to 5,374 short tons. In 1870 the Census Office reported the production at 17,844 tons. The production for the intervening years has been estimated by the writer and is shown in the following table which gives the production of the State from 1860 to the close of 1903:

Production of coal in Washington, 1860–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1860	5,374	1876	110,342
1861	6,000	1877	120,896
1862	7,000	1878	131,660
1863	8,000	1879	142,666
1864	10,000	1880	145,015
1865	12,000	1881	196,000
1866	13,000	1882	177,340
1867	14,500	1883	244,990
1868	15,000	1884	166,936
1869	16,200	1885	380,250
1870	17,844	1886	423,525
1871	20,000	1887	772,601
1872	23,000	1888	1,215,750
1873	26,000	1889	1,030,578
1874	30,352	1890	1,263,689
1875	99,568	1891	1,056,249

Production of coal in Washington, 1860–1903—Continued.

Year.	Quantity.	Year.	Quantity.
1892	1,213,427	1898	1,884,571
1893	1,264,877	1899	2,029,881
1894	1,106,470	1900	2,474,093
1895	1,191,410	1901	2,578,217
1896	1,195,504	1902	2,681,214
1897	1,434,112	1903	3,193,273

WEST VIRGINIA.

Total production in 1903, 29,337,241 short tons; spot value, $34,297,019.

The coal-mining industry in West Virginia in 1902 was considerably interfered with by labor troubles, which affected particularly the operations along New and Kanawha rivers, in the southern portions of the State. In consequence of these labor troubles, which were precipitated by the refusals of the operators in these districts to meet in joint conference the officers of the United Mine Workers of America, the operators did not participate fully in the benefits arising from the shortage of coal produced by the strike in the anthracite region of Pennsylvania. Notwithstanding the abnormal demand for bituminous coal which was occasioned by the strike in the anthracite region, the coal production of West Virginia in 1902 increased only 502,424 short tons, or 2.1 per cent over 1901. Had it not been for the labor troubles in the State the production would probably have shown an increase of ten times this amount. As a result of this strike the mines along the Kanawha River were not worked regularly and the operators in this district suffered consequently in the strike of 1902. So far as the New River was concerned the strike was unsuccessful. No labor troubles of consequence were experienced in 1903, the result of which is shown in the increased production for the State of 4,766,415 short tons, or 19 per cent in quantity, and of $9,548,361, or 38.6 per cent in value, over 1902. The average price per ton advanced from $1.01 in 1902 to $1.17 in 1903. This advance in price in connection with the increased production places West Virginia as third in rank in the value of the coal produced as well as in the quantity. Prior to 1903 Ohio, while ranking fourth in the quantity of production, exceeded West Virginia in the value of the product.

One of the interesting features in connection with the coal-mining industry in West Virginia has been the increase in the use of mining machines and in the quantity of coal produced thereby. In 1898 there were only 86 machines in use in the State; in 1903 there were 788 machines in use. In 1898 the machine-mined tonnage amounted to 1,323,929 short tons; in 1903 it amounted to 8,193,840 short tons.

Compared with 1902 the number of machines in use showed an increase of 209, and the machine-mined product an increase of 2,455,-795 short tons, or from 5,738,045 tons to 8,193,840 short tons.

The statistics of labor employed in the State show that in 1902 35,500 men were employed for an average of 205 days, producing an average of 692 tons per man for the year and 3.38 tons per man per day. In 1903, 41,554 men were employed for an average of 210 days and produced an average of 706 tons per man for the year and 3.36 per man per day. The average time made for the day in 1903 was nine hours. The details of production in 1902 and 1903 are shown in the following tables:

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	13,811	38,581	1,848,617	2,226,383	1.20	178	4,258
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	70,870	1.55	142	179
Total	19,847,321	628,903	267,885	3,831,717	24,570,826	24,748,658	1.01	205	35,500

Coal production of West Virginia in 1903, 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	682,469	7,663	14,408	38,388	742,928	$718,510	$0.97	247	1,084
Brooke	31,816	3,024	185	....	35,025	44,500	1.39	236	74
Fayette	5,031,073	83,743	113,644	863,733	6,092,193	7,559,612	1.24	184	10,067
Grant	65,523	2,069	11,340	....	78,932	97,872	1.24	225	234
Hancock	127,501	25,230	1,032	....	153,763	219,010	1.42	252	249
Harrison	2,408,042	13,936	26,992	55,668	2,504,638	2,829,660	1.13	189	3,023
Kanawha	2,917,805	50,031	34,913	32,163	3,034,912	3,446,651	1.14	196	5,242
McDowell	4,059,187	99,846	126,760	1,818,007	6,103,800	7,432,250	1.22	219	7,359
Marion	2,706,500	27,117	52,166	347,916	3,133,699	3,438,109	1.10	223	3,277
Marshall	299,310	66,292	7,295	....	372,897	444,937	1.19	233	547
Mason	65,171	53,049	9,426	....	127,646	154,604	1.21	235	276
Mercer	1,033,022	12,294	7,913	322,551	1,375,780	1,563,872	1.14	224	1,525
Mineral	517,862	8,042	3,195	....	529,099	766,787	1.45	222	667
Mingo	1,133,462	24,212	6,880	....	1,164,554	1,381,553	1.19	246	2,131
Monongalia	114,732	2,317	1,700	43,163	161,912	155,122	.96	244	198
Ohio	114,459	31,513	1,260	....	147,232	185,951	1.26	212	227
Preston	674,927	17,179	21,312	91,642	805,060	860,521	1.07	250	1,250
Putnam	291,043	3,901	3,555	....	298,499	408,180	1.37	254	835
Raleigh	406,051	6,328	5,080	....	417,459	543,091	1.30	156	958
Randolph	295,708	7,629	3,187	151,877	458,401	461,235	1.01	231	452
Taylor	278,811	8,969	2,430	1,936	292,146	312,748	1.07	191	534
Tucker	757,761	10,706	18,257	454,841	1,241,565	1,170,468	.94	275	1,222
Other counties[a]	44,414	4,786	850	....	50,050	88,864	1.78	184	158
Small mines	....	15,051	....	....	15,051	13,412	......	......	....
Total	24,056,649	584,927	473,780	4,221,885	29,337,241	34,297,019	1.17	210	41,554

[a] Braxton, Clay, Gilmer, Nichols, and Ritchie.

In the following table are shown the statistics of production by counties during the last five years, with the increases and decreases in 1903 as compared with 1902:

Coal production of West Virginia, by counties, 1899–1903.

[Short tons.]

County.	1899.	1900.	1901.	1902.	1903.	Increase, 1903.	Decrease, 1903.
Barbour	79,735	216,231	313,376	512,725	742,928	230,203	....
Brooke	77,246	60,970	73,198	40,372	35,025	....	5,347
Fayette	5,039,815	5,742,138	6,052,889	4,775,112	6,092,193	1,317,081	....
Grant	....	....	....	2,776	78,932	76,156	....
Hancock	....	....	....	80,400	153,763	73,363	....
Harrison	641,022	945,955	1,762,563	2,066,597	2,504,638	438,041	....
Kanawha	1,505,141	2,062,741	1,983,908	1,848,617	3,034,912	1,186,295	....
Lewis	....	....	....	540	....	....	540
McDowell	4,290,912	4,921,285	4,995,511	5,459,655	6,103,800	644,145	....
Marion	2,783,161	3,241,675	3,411,597	3,397,194	3,133,699	....	263,495
Marshall	289,436	231,571	217,287	243,791	372,897	129,106	....

Coal production of West Virginia, by counties, 1899–1903—Continued.

County.	1899.	1900.	1901.	1902.	1903.	Increase in 1903.	Decrease in 1903.
Mason	97,233	142,209	129,964	144,727	127,646	....	17,081
Mercer	898,405	1,009,536	964,028	1,248,279	1,375,780	127,501	....
Mineral	628,589	641,156	597,776	514,993	529,099	14,106	....
Mingo	481,150	574,156	576,886	806,174	1,164,554	358,380	....
Monongalia	51,520	87,400	110,801	153,474	161,912	8,438	....
Ohio	159,857	137,796	191,761	230,241	147,232	....	83,009
Preston	281,414	381,947	489,239	590,436	805,060	214,624	....
Putnam	210,821	137,870	242,789	184,259	298,499	114,240	....
Raleigh	86,088	90,507	148,493	281,817	417,459	135,642	....
Randolph	47,291	179,588	161,561	400,145	458,401	58,256	....
Taylor	378,765	523,258	380,590	368,650	292,146	....	76,504
Tucker	1,157,470	1,180,053	1,097,340	1,166,080	1,241,565	75,485	....
Other counties and small mines	167,974	139,215	167,400	53,772	65,101	11,329	....
Total	19,252,995	22,647,207	24,068,402	24,570,826	29,337,241	*a*4,766,415	....

a Net increase.

The distribution of the product for the last fifteen years is shown in the following table:

Distribution of the coal product of West Virginia, 1889–1903.

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
1903	24,056,649	584,927	473,780	4,221,885	29,337,241	34,297,019	1.17	210	41,554

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 higher geologic horizon than that of Fayette and Raleigh counties, but the district is practically compact and continuous, and is drained by the same waters and reached by the same railroad, so the two areas are considered as one district in this report.

Coal production of the principal districts of West Virginia, 1886–1903.

[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	2,879,296	1,357,040	520,064	508,343
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	3,187,012	1,150,569	1,052,306
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	927,239
1895	4,399,623	4,044,998	1,550,256	1,125,601
1896	4,650,455	4,608,118	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	2,561,218
1903	9,843,063	8,319,775	5,638,337	2,229,065

[a] Including production of Tazewell County, Va.

In order to show the great increase made by West Virginia as a coal-producing State the following table has been prepared. The statement shows that in twenty-three years there has only been one exception to a steadily increasing output, and that during the period the annual increase has exceeded 1,200,000 tons.

Annual increase in the coal production of West Virginia, 1881–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1882 over 1881	560,000	1896 over 1895	1,488,335
1883 over 1882	95,833	1897 over 1896	1,371,863
1884 over 1883	1,024,167	1898 over 1897	2,452,840
1885 over 1884	9,062	1899 over 1898	2,551,996
1886 over 1885	636,734	1900 over 1899	3,394,212
1887 over 1886	875,824	1901 over 1900	1,421,195
1888 over 1887	617,180	1902 over 1901	502,424
1889 over 1888	733,080	1903 over 1902	4,766,415
1890 over 1889	1,162,774	Total increase in 23 years	27,657,241
1891 over 1890	1,826,011	Average annual increase	1,202,489
1892 over 1891	518,090		
1893 over 1892	969,823		
1894 over 1893	919,179		
Total increase in 13 years	9,947,757		
Decrease in 1895	239,796		
Total increase in 14 years	9,707,961		

The annual production of coal in West Virginia since 1873 has been as follows:

Coal production of West Virginia, 1873–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1873	672,000	1889	6,231,880
1874	1,120,000	1890	7,394,654
1875	1,120,000	1891	9,220,665
1876	896,000	1892	9,738,755
1877	1,120,000	1893	10,708,578
1878	1,120,000	1894	11,627,757
1879	1,400,000	1895	11,387,961
1880 a	1,829,844	1896	12,876,296
1881	1,680,000	1897	14,248,159
1882	2,240,000	1898	16,700,999
1883	2,335,833	1899	19,252,995
1884	3,360,000	1900	22,647,207
1885	3,369,062	1901	24,068,402
1886	4,005,796	1902	24,570,826
1887	4,881,620	1903	29,337,241
1888	5,498,800		

a United States census, fiscal year.

WYOMING.

Total production in 1903, 4,635,293 short tons; spot value, $5,731,281.

Compared with 1902 the coal production of Wyoming shows an increase of 205,802 short tons, or 4.6 per cent, in quantity, and of $494,942, or 9.5 per cent, in value. The production in Wyoming in 1903, like that of most of the coal-producing States, was the largest ever obtained.

Of the total product in 1903,783, 822 short tons, or 16.91 per cent, was undercut by the use of mining machines, although the number of machines in use shows a decrease from 69 in 1902 to 59 in 1903.

According to the returns to the Survey for 1903, Wyoming has the record for the largest number of tons produced per man employed during the year, for the first time exceeding Maryland in this respect. This increase in the productive capacity per man in Wyoming was probably due to the larger amount of machine mined coal. The returns for 1903 show that the total production for the year was 928.4 tons per man, as compared with 843.7 tons per man in 1902. The average production per man per day was 3.68 tons in 1903, as compared with 3.4 tons in 1902. Maryland in the latter regard continues to hold the first place, having an average of 3.74 tons per man per day in both 1902 and 1903.

The statistics of production by counties during the last two years is shown in the following tables:

Coal production of Wyoming 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	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.

Coal production of Wyoming in 1903, 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.*				
Sweetwater	1,551,133	10,738	67,073	....	1,628,944	$1,923,618	$1.18	254	1,767
Uinta	1,704,751	16,983	60,934	....	1,782,668	2,036,451	1.14	257	1,599
Other counties[a]	1,115,727	17,949	65,914	22,000	1,221,590	1,767,141	1.45	246	1,627
Small mines	....	2,091	....	....	2,091	4,071	....	....	....
Total	4,371,611	47,761	193,921	22,000	4,635,293	5,731,281	1.24	252	4,993

[a] Carbon, Converse, Crook, Fremont, Johnson, 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, 1889–1903.

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	2,106,987	35,628	81,065	23,231	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
1903	4,371,611	47,761	193,921	22,000	4,635,293	5,731,281	1.24	252	4,993

Annual production of coal in Wyoming, 1868–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1868	6,925	1886	829,355
1869	49,382	1887	1,170,318
1870 a	50,000	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 a	589,595	1898	2,863,812
1881	420,000	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	1903	4,635,293

a United States census, fiscal year.

COKE.

By Edward W. Parker.

INTRODUCTION.

The statistics of the manufacture of coke as presented in this chapter and in the preceding ones of this series include only that product which is obtained from the distillation or partial cumbustion of bituminous coal in ovens of the beehive type, or in retort ovens of which the coke product is suitable for furnace and foundry use. The coke obtained as a by-product in the manufacture of illuminating gas and known as "gas-house coke" is not considered in this report. Gas-house coke is a spongy substance unfit for metallurgical use and is consumed chiefly as a domestic fuel. Owing, however, to certain changes and developments that have taken place in the manufacture of coke in the last ten years, it is necessary to include in these reports some coke which is not manufactured for strictly metallurgical purposes. When the publication of the annual report, "Mineral Resources of the United States," was begun in 1882, practically all of the coke (except gas-house coke) made in the United States was obtained from beehive ovens, the name of the oven being derived from the shape of the combustion chamber, which is similar to that of the conventional beehive.

During the last decade, however, there has been a steady and noteworthy increase in the construction of retort or by-product recovery ovens, the coke product of which is a high-grade metallurgical fuel, although the coke itself is not in all cases the primary product. In some instances the coke is a secondary product, but can not be considered as a by-product, like gas-house coke. And while considerable quantities of the coke made in by-product ovens are sold for other than metallurgical purposes, it is also true that manufacturers of beehive coke are now making a specialty of the preparation of coke for domestic use, and large quantities of this fuel were sold in 1902 to take the place of anthracite coal, made scarce by the great strike of that year. It is impossible to make any separation of the coke sold for domestic use, and as the greater part of the by-product coke made is used for metallurgical purposes, it is considered as coming within the scope of this chapter, and it is no longer possible to limit the report, as formerly, to the production of blast furnace and foundry coke.

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. Construction work on a plant of 50 retort ovens was begun during 1903 at West Duluth, Minn. The ovens in Michigan and those recently constructed in Maryland (near Baltimore) are 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. At the close of 1903, a plant of 80 retort ovens was under construction at Milwaukee.

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.

The production of coke in 1903 showed a slight reaction from that of the previous year, during which time, because of the continued activity in the iron and steel trade and of the scarcity of anthracite coal, an unprecedented demand was created for coke. Including the production of coke from by-product or retort ovens, the total output in 1903 amounted to 25,262,360 short tons, as against 25,401,730 short tons in 1902. The decrease in production in 1903 as compared with the preceding year was 139,370 short tons or 0.55 per cent. Considering the abnormal conditions which obtained in 1902, the continued large production in 1903 is noteworthy and the slight decrease in tonnage is negligible. Compared with 1901, when the coke production amounted to 21,795,883 short tons, the output for 1903 shows a normal increase.

Notwithstanding the somewhat smaller quantity of coke made in 1903, as compared with the preceding year, the value of the product showed a substantial gain, increasing from $63,339,167 in 1902 to $66,459,623 in 1903, a gain of $3,120,456, or a little more than 5 per cent. The value of the product in 1902 exceeded that of 1901 by $18,893,244, or 42.5 per cent, the increase being due to the anthracite coal famine, which sent coke prices far above all previous records. In September and October of 1902 when contract prices for Connellsville furnace coke were 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, "spot" prices fell off somewhat; but as late as December prompt-delivery coke was still commanding as high as $5 and $6 per ton. In fact, these prices continued well into 1903, and were even somewhat advanced, Connellsville furnace coke bringing over $6 for prompt delivery during January, February, March, and April, while contracts for delivery in six months were made at from $3.75 to $4 per ton. Immediate requirements having been supplied during the first four months, prices slumped suddenly in May, a reduction of nearly 50 per cent being made. By the time the summer was well advanced the supply of coke had exceeded the demand, and prices continued to decline. Connellsville furnace coke in June was sold on six-months' contracts at from $2.75 to $3. By July, with continued oversupply, the prices had again declined to $2.25. Still further declines were shown during August, September, and October, until as low as $1.75 was reached for strictly Connellsville furnace coke, and even that price was shaded somewhat before the end of the year.

The higher value for the coke product of 1903 as compared with the preceding year was due, therefore, to the unusual conditions which existed during the first few months of the year and which were left over as a legacy from 1902. It was not due to any healthful condition of the industry during 1903.

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 price. 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, which retired from the general market in 1902 with the purpose of disposing of its entire production to the United States Steel Corporation, resumed production for the outside market in the latter part of 1903.

Stimulated by the active demand for coke which prevailed in 1902, new construction was energetically carried forward, and during 1903 over 10,000 new ovens were added to those already built. At the close of 1902 the total number of coke ovens in the United States was 69,069. At the close of 1903 the number had increased to 79,187, a gain of 10,118. The number of ovens idle during 1902 was 1,945, leaving a total of 67,124 active ovens, which produced 25,401,730 tons of coke, or an average of 378.4 tons per oven. In 1903 the number of ovens idle throughout the year was 1,999, leaving a total of 77,188 active ovens, which turned out 25,262,360 tons of coke, or an average of 327.3 tons per oven.

The total number of 77,188 active ovens in 1903 included 1,956 by-product ovens, which produced 1,882,394 tons of coke, or an average of 962.4 tons per oven. Deducting the number of by-product ovens from the total number of ovens active in 1903, it appears that there were 75,232 beehive ovens, which produced a total of 23,379,966 tons of coke, or an average of 311 tons each, or less than one-third the tonnage per oven of the by-product ovens operated during the year.

There were under construction at the close of 1902, 6,275 new ovens, of which 1,335, or about 21 per cent, 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 to 1,956 in 1903. The output from retort ovens has increased from 1,179,900 tons in 1901 to 1,403,588 tons in 1902, and to 1,882,394 tons in 1903. In 1902, 5.5 per cent of the total output was from by-product ovens; in 1903 the by-product coke was 7.4 per cent of the total.

Counting each bank of ovens as a separate establishment, the returns for 1903 show a total of 500 establishments, as compared with 456 in 1902. Forty-one establishments, all comparatively unimportant, were idle throughout the year. There were also 18 new establishments, having a total of 2,936 ovens, which were not completed and put in blast at the close of 1902.

The details of the production of coke in 1902 and 1903 are presented, by States and Territories, in the following tables:

Manufacture of coke in the United States, by States and Territories, in 1902.

State or Territory.	Establishments.	Ovens.		Coal used.	Yield of coal in coke.	Coke produced.	Total value of coke.	Value of coke per ton.
		Built.	Building.					
				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	8	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	852,977	70.2	598,869	2,063,894	3.446
Indiana	1	50	0					
Massachusetts	1	400	0					
Michigan	2	75	60					
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 Wilcox ovens.

Manufacture of coke in the United States, by States and Territories, in 1903.

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	39	8,764	381	4,483,942	60	2,693,497	$7,622,528	$2.83
Colorado[a]	16	3,455	0	1,776,974	59.3	1,053,840	3,089,788	2.93
Georgia	2	500	0	146,066	58.5	85,546	368,351	4.306
Indian Territory	5	286	0	110,088	45	49,818	227,542	4.57
Kansas	9	91	0	30,503	46.5	14,194	50,221	3.54
Kentucky	7	499	0	247,950	46.5	115,362	306,327	2.65
Minnesota	1	0	50	....	....	....	....	....
Missouri	2	8	0	3,004	61.2	1,839	5,797	3.15
Montana	4	555	100	82,118	54.9	45,107	310,882	6.89
New Mexico	2	126	0	18,613	59.4	11,050	31,589	2.86
Ohio	8	440	66	211,473	68	143,913	528,142	3.67
Pennsylvania	212	40,092	1,785	23,706,455	65.9	15,639,011	38,930,060	2.49
Tennessee	16	2,439	304	1,001,356	54.6	546,875	1,706,722	3.12
Utah[b]	2	504	0	....	....	....	....	....
Virginia	16	4,251	142	1,860,225	63.2	1,176,439	2,724,047	2.315
Washington	6	256	0	73,119	62.4	45,623	214,776	4.71
West Virginia	136	15,613	2,687	4,347,160	62.3	2,707,818	7,115,842	2.628
Illinois	5	155	120	1,306,707	71.3	932,428	3,228,064	3.46
Indiana	1	36	0					
Maryland	1	200	0					
Massachusetts	1	400	0					
Michigan	2	75	60					
New Jersey	1	100	0					
New York	3	40	500					
Wisconsin	2	228	80					
Wyoming	1	74	0					
Total	500	[c]79,187	[d]6,275	39,405,773	64.1	25,262,360	66,459,623	2.63

[a] Includes the production of Utah.
[b] Included with Colorado.
[c] Includes 565 Semet-Solvay, 1,335 Otto-Hoffman, and 56 Newton-Chambers ovens.
[d] Includes 490 Semet-Solvay, 779 Otto-Hoffman, and 66 Wilcox ovens.

Of the 25 States and Territories that produced coke in 1903 there were 8 in which the output was less than in 1902. The largest decrease was in Pennsylvania, whose production fell off 858,899 tons, or 5.2 per cent. The other decreases were comparatively unimportant. The largest increase was made by West Virginia, which gained 191,313 tons, or 7.6 per cent, and Alabama was second with an increase of 141,251 tons, or 5.5 per cent. The combined production of Illinois, Indiana, Maryland, Massachusetts, Michigan, New Jersey, New York, Wisconsin, and Wyoming, most of which was by-product coke, showed an increase of 333,559 tons, or 55.7 per cent. In fact the total production of by-product coke increased 478,806 tons over 1902, showing that the decrease in beehive coke amounted to 618,176 tons, and the net decrease to 139,370 tons.

The increases and decreases in the several States during 1903, as compared with 1902, are shown in the following table:

Increases and decreases in coke production, by States, in 1903, as compared with 1902.

[Short tons.]

State or Territory.	Production.		Increase.		Decrease.	
	1902.	1903.	Quantity.	Per cent.	Quantity.	Per cent.
Alabama	2,552,246	2,693,497	141,251	5.53		
Colorado[a]	1,003,393	1,053,840	50,447	5.02		
Georgia	82,064	85,546	3,482	4.24		
Indian Territory	49,441	49,818	377	.76		
Kansas	20,902	14,194			6,708	32.09
Kentucky	126,879	115,362			11,517	9.08
Missouri	5,780	1,839			3,941	68.18
Montana	53,463	45,107			8,356	15.63
New Mexico	23,296	11,050			12,246	52.57
Ohio	146,099	143,913			2,186	1.496
Pennsylvania	16,497,910	15,639,011			858,899	5.206
Tennessee	560,006	546,875			13,131	2.344
Virginia	1,124,572	1,176,439	51,867	4.612		
Washington	40,305	45,623	5,318	13.19		
West Virginia	2,516,505	2,707,818	191,313	7.602		
Illinois, Indiana, Maryland, Massachusetts, Michigan, New Jersey, New York, Wisconsin, Wyoming	598,869	932,428	333,559	55.7		
Total	25,401,730	25,262,360			139,370	.5486

[a] Includes Utah.

The earliest record of coke production in the United States is that contained in the census report for 1880. In that year the total production of coke amounted to 3,338,300 short tons. Five years prior to that date, according to statistics compiled by the American Iron and Steel Association, the use of coke in iron furnaces exceeded that of anthracite coal. The same authority states that prior to 1855 most of the iron made in this country was made with charcoal. In that year anthracite took the lead and maintained it until passed by coke in 1875. Six years earlier coke had taken the lead over charcoal. Now very little iron is made with anthracite, and charcoal is used only for making special brands of pig iron. 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 1903, inclusive:

Statistics of the manufacture of coke in the United States, 1880–1903.

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	14,348,750	9,203,632	12,328,856	1.34	64
1895	265	45,565	638	20,848,323	13,333,714	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
1903	500	79,187	6,275	39,405,773	25,262,360	66,459,623	2.63	64.1

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 pages 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	1903, December 31	500

The 500 establishments which were in existence on December 31, 1903, included 18, with a total of 2,936 ovens, which were not entirely completed before the close of the year and did not contribute to the production in 1903. There were also 41 establishments, having a total of 1,999 ovens, whose ovens were not operated at all during the entire year. These idle plants were all comparatively small, averaging only 49 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 1903—that is to say, 41 old ones that were idle and 18 new ones which had not begun operations—the total number of active plants last year was 441, a little over two and one-third times 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 1903, considering each bank of ovens as a separate establishment, the average productive capacity for each plant was 57,290 tons, or 3.2 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 six years from 1898 to 1903, 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 1900 to 1903 was more than the increase in the nine years from 1891 to 1900. The 79,187 ovens completed at the end of 1903 include 1,956 by-product recovery ovens.

Number of coke ovens in each State at the close of each year, 1898–1903.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.
Alabama	5,456	5,599	6,529	7,136	7,571	8,764
Colorado	1,253	1,243	1,488	2,060	3,010	3,455
Georgia	350	350	480	510	492	560
Illinois	126	130	154	154	149	155
Indiana	94	52	54	54	50	36
Indian Territory	130	130	230	230	280	286
Kansas	47	95	91	98	97	91
Kentucky	292	300	458	461	485	499
Maryland	....	....	....	....	....	200
Massachusetts	....	400	400	400	400	400
Michigan	....	....	....	30	75	75
Missouri	8	12	10	9	8	8
Montana	318	303	342	328	410	555
New Jersey	....	....	....	....	100	100
New Mexico	126	126	126	126	126	126
New York	25	25	30	30	30	40
Ohio	441	385	369	419	449	440
Pennsylvania	27,157	27,591	32,548	34,906	36,609	40,602
Tennessee	1,949	2,040	2,107	2,135	2,269	2,439
Utah	104	104	204	204	404	504
Virginia	1,564	1,588	2,331	2,775	2,974	4,251
Washington	90	90	90	148	231	256
West Virginia	8,659	8,846	10,249	11,544	12,656	15,613
Wisconsin	120	120	120	120	120	228
Wyoming	74	74	74	74	74	74
Total	48,383	49,603	58,484	63,951	69,069	79,187

Number of coke ovens in the United States on December 31 of each year, 1880–1903.

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	1903	79,187

A statement of the number of ovens in course of construction at the end of each year since 1880 is shown in the following table. It is not intended to show by this the increase in the number of ovens from year to year, nor does it include the new ovens completed during any one year. It exhibits merely the condition of the industry as represented by plants under construction at the close of each year.

Number of coke ovens building in the United States at the close of each year, 1880–1903.

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	4,087
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	1903	6,275

The activity in the production of coke in 1902 is reflected in the above table by the large number of new ovens building at the close of the year, there being 50 per cent more new ovens under construction at the close of that year than there were at the close of 1900, which had the largest number prior to 1902. A considerable decrease is shown in the statistics for 1903 as compared with 1902, but in spite of this there were more ovens building at the close of 1903 than in any other year except 1902. Of the new ovens building in 1903, 1,335, or 21 per cent, were by-product ovens.

PRODUCTION IN PREVIOUS YEARS.

The statistics of the production of coke in each State and Territory for the last six years, and the total annual production since 1880, are shown in the following tables. During the twenty-four years covered by these reports there have been six in which the production decreased as compared with the preceding year. The most notable decreases were those shown in the production of 1893 and 1894, and were due to the panic and depression which made those years memorable in our recent industrial history. The temporary boom of 1895 was followed by another period of depression in 1896, which was also reflected in a decreased coke production. The slight decrease of 1903 was fortunately due to other causes, which have already been explained.

Quantity of coke produced in the United States, 1898–1903, by States and Territories.

[Short tons.]

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.
Alabama	1,663,020	1,787,809	2,110,887	2,148,911	2,552,246	2,693,497
Colorado [a]	445,982	530,424	618,755	671,303	1,008,393	1,053,840
Georgia	49,529	50,907	73,928	54,550	82,064	85,546
Indian Territory	34,110	24,339	38,141	37,374	49,441	49,818
Kansas	4,180	14,476	5,948	7,138	20,902	14,194
Kentucky	22,242	31,095	95,532	100,285	126,879	115,362
Missouri	740	2,860	2,087	4,749	5,780	1,839
Montana	52,009	56,376	54,781	57,004	53,463	45,107
New Mexico	6,980	44,134	44,774	41,643	23,296	11,060
Ohio	85,535	83,878	72,116	108,774	146,099	143,913
Pennsylvania	[b]10,715,302	[b]13,577,870	13,357,295	14,355,917	16,497,910	15,639,011
Tennessee	394,545	435,308	475,432	404,017	560,006	546,875
Utah	28,826	(a)	(a)	(a)	(a)	(a)
Virginia	531,161	618,707	685,156	907,130	1,124,572	1,176,439
Washington	30,197	30,372	33,387	49,197	40,305	45,623
West Virginia	1,925,071	2,278,577	2,358,499	2,283,700	2,516,505	2,707,818
Illinois	2,325	2,370				
Indiana	1,825					
Maryland	....	....				
Massachusetts	....	(c)				
Michigan	....	....	506,730	564,191	598,869	932,428
New Jersey	....	....				
New York	(c)	(c)				
Wisconsin	35,280	33,437				
Wyoming	18,350	15,630				
Total	16,047,209	19,668,569	20,533,348	21,795,883	25,401,730	25,262,360

[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:

Quantity of coke produced in the United States, 1880–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
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	1903	25,262,360

VALUE OF COKE PRODUCED.

Although the amount of coke produced in the United States in 1903 was less than that of the preceding year, the total value of the product exceeded that of 1902 by $3,119,456, or about 5 per cent. All of this gain in value was made in the first half of the year, and was due to the altogether unprecedented demand for coke which attended, and for some months followed, the strike in the anthracite regions of Pennsylvania. During the first four months of 1903 Connellsville coke was eagerly sought at from $6 to $7 per ton for prompt delivery, and contracts were made for six months' delivery at $3.75 to $4. A decided reaction set in during May, and from that time on the record for the year was one of overproduction and falling prices until as low as $1.75 was reached for Connellsville furnace coke, and the year closed with even that figure subject to some shading. Some spot coke sold at the height of the coal famine in 1902 brought as much as $10 to $12 per ton, but such cases were exceptional. Nearly all of the coke produced was sold on contracts made early in the year, and that these contracts were lived up to is shown by the comparatively slight increase made in the average price over 1901, when low prices were the rule. It is true, nevertheless, that operators secured all the benefit possible out of any coke of which they were able to make prompt delivery. The contracts made in the latter part of 1902 and the early part of 1903 were made at higher figures than those which obtained during 1902, and these, added to the continued high prices for prompt delivery, make 1903 the banner year in the average value of all the coke sold.

The total value of the coke product of 1903 was $66,459,623, an increase of $3,119,456, or 5 per cent, over 1902, and a gain of 50 per cent over 1901. The 1903 value was nearly double that of 1899, and was more than three times that of 1897.

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, 1898–1903, by States and Territories.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.
Alabama	$3,378,946	$3,634,471	$5,629,423	$6,062,616	$8,300,838	$7,622,528
Colorado	[a]1,230,428	[a]1,333,769	[a]1,746,732	[a]1,626,279	[a]2,754,341	[a]3,069,783
Georgia	77,230	116,917	210,646	154,625	298,963	368,351
Indian Territory	96,639	71,965	152,204	154,834	202,921	227,542
Kansas	6,455	30,817	14,985	15,079	54,702	50,221
Kentucky	32,213	161,454	235,505	208,015	317,875	305,327
Missouri	1,050	5,520	5,268	9,968	14,450	5,797
Montana	359,174	356,190	337,079	337,381	360,927	310,882
New Mexico	14,625	99,217	130,251	118,368	74,051	31,539
Ohio	211,558	255,129	194,042	299,430	492,793	528,142
Pennsylvania	[b]16,078,505	[c]22,881,910	29,692,258	27,066,361	38,451,722	38,930,060
Tennessee	642,920	850,686	1,269,555	952,782	1,597,041	1,706,722
Utah	(d)	(d)	(d)	(d)	(d)	(d)
Virginia	699,781	1,071,284	1,464,556	1,483,670	2,322,228	2,724,047
Washington	128,933	151,216	160,165	239,028	199,195	214,776
West Virginia	2,432,657	3,480,408	4,746,633	4,110,011	5,833,226	7,115,842
Illinois	4,686	5,565				
Indiana	3,194					
Maryland	....	....				
Massachusetts	....	(e)				
Michigan	....	....	1,454,029	1,607,476	2,063,894	3,228,064
New Jersey	....	....				
New York	(e)	(e)				
Wisconsin	123,480	125,389				
Wyoming	64,225	38,510				
Total	25,586,699	34,670,417	47,443,831	44,445,923	63,339,167	66,459,623

[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, 1880–1903.

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	1903	66,459,623

From the preceding statements, showing the quantity 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 quality 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-four years was that of 1903, when the average for all qualities and in all States reached as high as $2.63, an increase of 14 cents, or 5.6 per cent, over 1902. The average price for all coke sold in 1902 exceeded by 45 cents, or 22.1 per cent, that of 1901, and was 18 cents, or 7.8 per cent above that of 1900, when the prices of coke reached the highest point prior to 1902. As previously explained, the high average prices obtained in 1902 and 1903 were due to the anthracite coal strike and to the shortage of fuel caused thereby.

Average value per short ton at the ovens of the coke made in the United States, 1898–1903, by States and Territories.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.
Alabama	$2.03	$2.03	$2.667	$2.82	$3.25	$2.83
Colorado	a2.59	a2.51	a2.82	a2.42	a2.74	a2.93
Georgia	1.56	2.30	2.849	2.83	3.643	4.306
Indian Territory	2.833	2.96	3.99	4.14	4.10	4.57
Kansas	1.544	2.18	2.52	2.11	2.617	3.54
Kentucky	1.448	1.99	2.465	2.07	2.505	2.65
Missouri	1.42	1.98	2.52	2.099	2.50	3.15
Montana	6.906	6.32	6.159	5.918	6.75	6.89
New Mexico	2.095	2.25	2.909	2.84	3.178	2.85
Ohio	2.47	3.04	2.69	2.75	3.37	3.67
Pennsylvania	b1.50	b1.69	2.22	1.885	2.83	2.49
Tennessee	1.63	1.95	2.67	2.358	2.85	3.12
Utah	(c)	(c)	(c)	(c)	(c)	(c)
Virginia	1.317	1.73	2.137	1.635	2.065	2.315
Washington	4.27	4.98	4.797	4.858	4.94	4.71
West Virginia	1.26	1.53	2.01	1.80	2.318	2.628
Illinois	2.02	2.35				
Indiana	1.75					
Maryland	....	....				
Massachusetts	....	(d)				
Michigan	....	....	2.87	2.849	3.446	3.46
New Jersey	....	....				
New York	(d)	(d)				
Wisconsin	3.50	3.75				
Wyoming	3.50	2.46				
Average	1.594	1.76	2.31	2.039	2.49	2.63

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, 1880–1903.

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	1.84	1902	2.49
1887	2.01	1895	1.44	1903	2.63

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 1903. 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, the industry in the latter State having been disturbed by labor strikes. West Virginia recovered her former position in 1903 by a narrow margin, both States showing substantial increases in that year over 1902. Maryland and New Jersey, each of which began production for the first time in 1903, took eighth and thirteenth places, respectively.

Rank of the States and Territories in production of coke, 1880–1903.

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

Rank of States and Territories in production of coke, 1880–1903—Continued.

State or Territory.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Pennsylvania	1	1	1	1	1	1	1	1	1	1	1	1	1
West Virginia	3	3	3	2	3	2	2	2	2	2	2	3	2
Alabama	2	2	2	3	2	3	3	3	3	3	3	2	3
Virginia	6	6	6	6	6	6	5	4	4	4	4	4	4
Colorado	5	4	4	4	5	4	6	5	5	5	5	5	5
Tennessee	4	5	5	5	4	5	4	6	6	6	7	6	6
Massachusetts	......	......	......	......	......	......	......	......	7	7	6	7	7
Maryland	......	......	......	......	......	......	......	......	......	......	......	......	8
Utah	14	13	11	12	11	14	15	13	16	15	12	10	9
Ohio	8	8	10	8	8	7	7	7	8	10	8	8	10
Michigan	......	......	......	......	......	......	......	......	......	......	20	14	11
Kentucky	10	9	8	9	9	10	10	15	9	8	9	9	12
New Jersey	......	......	......	......	......	......	......	......	......	......	......	......	13
Georgia	7	7	7	7	7	9	9	9	11	9	11	11	14
Wisconsin	9	11	12	18	17	17	16	10	13	12	13	12	15
New York	......	......	18	11	12	16	12	14	15	16	16	16	16
Indian Territory	13	16	15	19	16	13	11	11	17	14	17	15	17
Washington	16	15	16	16	13	11	13	12	14	17	14	17	18
Montana	11	10	9	10	10	8	8	8	10	11	10	13	19
Kansas	12	12	14	13	15	18	17	18	19	19	19	19	20
New Mexico	20	......	18	15	14	12	21	17	12	13	15	18	21
Wyoming	19	......	20	17	18	15	14	16	18	18	18	20	22
Illinois	17	18	21	21	20	20	20	19	22	22	22	22	23
Missouri	15	14	17	20	21	21	19	21	20	20	21	21	24
Indiana	18	17	19	14	19	19	18	20	21	21	......	......	25
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 quantities 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 1898 to 1903, 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, 1898–1903, by States and Territories.

[Short tons.]

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.
Alabama	2,814,615	3,028,472	3,582,547	3,849,908	4,237,491	4,483,942
Colorado	a 803,686	a 898,207	a 997,861	a 1,148,901	a 1,695,188	a 1,776,974
Georgia	81,108	78,098	140,988	89,919	129,642	146,066
Indian Territory	73,330	59,255	79,534	74,746	110,934	110,088
Kansas	7,856	26,988	10,303	11,629	35,827	30,503
Kentucky	44,484	151,508	190,268	204,297	265,121	247,950
Missouri	1,500	5,320	3,775	9,041	10,430	3,004
Montana	92,552	110,274	108,710	102,950	99,628	82,118
New Mexico	12,557	68,594	74,261	72,350	40,943	18,613
Ohio	134,757	142,678	115,269	162,624	219,401	211,473
Pennsylvania	c 16,807,841	d 19,930,419	20,239,966	21,736,467	25,017,326	23,706,455
Tennessee	722,356	779,995	854,789	739,246	1,025,864	1,001,356
Utah	(e)	(e)	(e)	(e)	(e)	(e)
Virginia	852,972	994,635	1,083,827	1,400,231	1,716,110	1,860,225
Washington	48,559	50,813	54,310	78,398	68,546	73,119
West Virginia	3,145,398	3,802,825	3,868,840	3,734,076	4,078,579	4,347,160
Illinois	6,650	4,217				
Indiana	4,065					
Maryland	....	....				
Massachusetts	....	(b)				
Michigan	....	....	708,295	793,187	852,977	1,806,707
New Jersey	....	....				
New York	(b)	(b)				
Wisconsin	59,900	54,950				
Wyoming	35,384	32,100				
Total	25,249,570	30,219,343	32,113,543	34,207,965	39,604,007	39,406,773

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, 1880–1903.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
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	1903	39,405,773

QUANTITY AND VALUE OF COAL USED IN COKE MAKING.

The total quantity of the coal used in the manufacture of coke and the value thereof in 1902 and 1903, 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 1903 was 39,405,773 short tons as compared with 39,604,007 short tons in 1902. The value of the coal consumed in 1903 was $42,427,922 against $39,301,194 in 1902, showing that although the quantity of coal used in 1903 was nearly 200,000 tons less than 1902, the value increased $3,126,728. It also shows that the increase of $3,119,456 in the value of the coke produced in 1903 was more than eaten up by the increased cost of the coal at the coke ovens.

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, by States and Territories.

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	1.906
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.

Quantity and value of coal used in the manufacture of coke in the United States in 1903, and quantity and value of same per ton of coke, by States and Territories.

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	4,483,942	$5,312,276	$1.185	1.66	$1.967
Colorado [a]	1,776,974	1,550,149	.872	1.686	1.27
Georgia	146,086	137,061	.938	1.707	1.60
Indian Territory	110,088	106,976	.97	2.21	2.141
Kansas	30,503	39,717	1.30	2.15	2.795
Kentucky	247,950	165,423	.667	2.15	1.434
Missouri	3,004	3,558	1.18	1.63	1.923
Montana	82,118	275,368	3.35	1.82	6.097
New Mexico	18,613	17,746	.95	1.684	1.60
Ohio	211,473	393,333	1.86	1.47	2.734
Pennsylvania	23,706,455	24,357,521	1.027	1.516	1.557
Tennessee	1,001,356	1,128,442	1.13	1.83	2.068
Virginia	1,860,225	1,540,365	.828	1.58	1.308
Washington	73,119	175,274	2.397	1.60	3.835
West Virginia	4,347,160	4,425,149	1.018	1.60	1.629
Illinois, Indiana, Maryland, Massachusetts, Michigan, New Jersey, New York, Wisconsin, Wyoming	1,306,707	2,799,569	2.14	1.40	2.996
Total	39,405,773	42,427,922	1.077	1.56	1.68

[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	1903	1.56	3,120

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 remain 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.

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, 1898–1903, by States.

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.
Alabama	59	59	58.9	55.8	60.2	60
Colorado [a]	59.1	59	62	58.4	59.2	59.3
Georgia	61	65.2	52.4	60.7	63.3	58.5
Indian Territory	46.5	41	48	50	44.6	45
Kansas	58	53.6	57.7	61.4	58.3	46.5
Kentucky	50	58.5	50.2	49	47.8	46.5
Missouri	49.3	58.8	55.3	52.5	55.4	61.2
Montana	56	51	50.3	55.4	53.7	54.9
New Mexico	55.6	64.3	60.3	57.5	56.9	59.4
Ohio	63.5	58.8	62.5	66.9	66.6	63
Pennsylvania	[b] 65.7	[b] 63.1	66	66	65.9	65.9
Tennessee	54.6	55.8	55.6	54.6	54.6	54.6
Virginia	62	62.2	63.2	64.7	65.5	63.2
Washington	62.2	59.8	61.5	62.7	58.8	62.4
West Virginia	61.2	60	60.9	61.1	61.7	62.8
Illinois	35	56.2				
Indiana	44.9					
Maryland	....	....				
Massachusetts	....	....				
Michigan	....	....	71.5	71.1	70.2	71.8
New Jersey	....	....				
New York	....	....				
Wisconsin	59	60.8				
Wyoming	51.9	48.7				
Total average	63.6	65.1	63.9	63.7	64.1	64.1

[a] Average, including Utah. [b] Average, including New York, also Massachusetts for 1899.

Percentage yield of coal in coke, 1880–1903.

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	1903	64.1

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 fourteen 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 used in coke making is run-of-mine coal, most of 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 1903, 12,854,875 short tons, or not quite one-third of the total quantity of coal used in coke making, was slack, and not quite one-half of this slack coal was washed before being coked. The total quantity of slack coal washed before coking in 1903 exceeded that of the preceding year by 288,475 tons, and the quantity of washed run-of-mine coal used showed an increase of 219,127 tons. Altogether the quantity of coal washed in 1903 was 507,602 tons more than in 1902.

Among the more important coal-producing States it is noted that in Pennsylvania only 1,445,630 tons, out of a total of 23,706,455 tons, were washed before coking. In Alabama 3,124,492 tons, out of a total of 4,483,942 tons, were washed; and in Colorado 1,182,390 tons, all of which was slack, out of a total of 1,776,974 tons, were washed before coking. In this State only 831 tons of run-of-mine coal were made into coke in 1902, and none in 1903. 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 quantity of unwashed run-of-mine coal used in coke making decreased from 26,347,698 short tons in 1902 to 24,683,953 tons in 1903. The quantity of washed run-of-mine coal used increased from 1,647,818 tons in 1902 to 1,866,945 tons in 1903. The use of unwashed slack increased from 5,781,088 tons to 6,738,997 tons, and the washed slack from 5,827,403 tons to 6,115,878 tons. The quantity of washed slack coal used in coke making in 1903 was more than three times the quantity consumed in 1896, while the total quantity of coal used was a little more than double.

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	1,262,398	0	2,517,223	298,963	4,078,579
Illinois Indiana Massachusetts New York Wisconsin Wyoming	735,194	0	117,528	256	852,977
Total	26,347,698	1,647,818	5,781,088	5,827,403	39,604,007

[a] Includes Utah.

Character of coal used in the manufacture of coke in 1903.

[Short tons.]

State or Territory.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
Alabama	1,359,450	602,446	0	2,522,046	4,483,942
Colorado [a]	0	0	594,584	1,182,390	1,776,974
Georgia	39,750	0	0	106,336	146,086
Indian Territory	331	0	1,295	108,462	110,088
Kansas	0	3,701	10,708	16,094	30,503
Kentucky	50	55,062	88,060	104,778	247,950
Missouri	0	0	3,004	0	3,004
Montana	1,891	80,227	0	0	82,118
New Mexico	0	0	855	17,758	18,613
Ohio	174,544	0	9,216	27,718	211,478
Pennsylvania	20,279,281	644,441	1,981,544	801,189	23,706,455
Tennessee	157,717	404,949	74,560	364,130	1,001,356
Virginia	857,332	0	1,002,893	0	1,860,225
Washington	0	73,119	0	0	73,119
West Virginia	1,149,761	3,000	2,890,310	304,089	4,347,160
Illinois, Indiana, Maryland, Massachusetts, Michigan, New Jersey, New York, Wisconsin, Wyoming	663,846	0	81,968	560,893	1,306,707
Total	24,683,953	1,866,945	6,738,997	6,115,878	39,405,773

[a] Includes Utah.

In the following table the statistics regarding the character of the coal for the years 1890 to 1903, inclusive, are consolidated:

Character of coal used in the manufacture of coke in the United States, 1890–1903.

[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	4,976,787	2,913,730	30,219,393
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
1903	24,683,953	1,866,945	6,738,997	6,115,878	39,405,773

COKE MAKING IN BY-PRODUCT OVENS.

The statistics relating to the manufacture of coke in by-product ovens show that the total number of ovens completed and in blast increased from 1,663 in 1902 to 1,956 in 1903, and that the production of by-product coke increased from 1,403,588 short tons to 1,882,394 short tons, a gain of 478,806 tons, although the total coke production fell off 139,370 tons. There were under construction at the close of 1903, 1,335 new by-product ovens, which number constituted more than 20 per cent of the total new ovens building at that time.

Although nearly 300 of the by-product ovens operated in 1903 were not put in blast until sometime after the first of the year, the general average production per oven for the year was 962.4 short tons. In 1902 the average production per oven was 844 tons. The average production in each beehive oven in 1903 was 311 tons.

In order to produce the 1,882,394 tons of coke there were used in the by-product ovens in 1903, 2,605,453 short tons of coal, showing a yield of coal in coke of 72.25 per cent, a much larger yield than is or can possibly be obtained in the operation of the beehive ovens. As previously shown, the average yield of coal in coke for all the United States (including the output of by-product ovens) in 1903, was 64 per cent, and this is probably higher than the results actually obtained.

In 1893 the first plant of by-product recovery ovens in the United States was completed at Syracuse, N. Y. At the close of 1903 there were nearly 2,000 ovens in operation, the plants being distributed through ten different States. Of the 1,335 ovens building at the close of 1903, 250 were distributed among three new States—Illinois, at South Chicago; Minnesota, at West Duluth; and Wisconsin, at Milwaukee. When all of these new ovens are completed, making a total of 3,291 by-product ovens, their production, at an average of 1,000 tons per oven per year, will be equivalent to 13 per cent of the total product of the United States in 1903. In 1902, 5.5 per cent of the total production of coke was made in by-product ovens. In 1903, 7.4 per cent of the total was by-product coke.

The statistics of the production of gas, tar, and ammonia in by-product ovens, which, until 1902, were discussed in this chapter, will be found in a separate chapter devoted to those subjects.

The most important development in connection with the retort coke-oven industry in recent years has been the merging of interests by the Semet-Solvay Company, of Syracuse, N. Y., and the United Coke and Gas Company, controlling the Otto-Hoffman ovens, of New York City. The merging was effected by the Semet-Solvay Company acquiring by lease the control of the business of the United Coke and Gas Company, a step practically made imperative by the conditions which were facing the two great rivals, and it is believed that with the economies of administration now made possible the business can be pushed to advantage.

The Semet-Solvay Company has made the American Coal Products Company, of New York, its selling agency for all the tar and ammonia produced in all the ovens controlled by it. As the profitable manufacture of by-product coke depends in large measure upon the ability to dispose of the by-products at remunerative prices, the development of markets for the increasing quantities of these by-products is an interesting and important branch of the industry.

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, 1893–1903.

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	1,663	1,346	1,403,588
1903	a 1,956	b 1,335	1,882,394

a Includes 565 Semet-Solvay, 1,335 Otto-Hoffman, and 56 Newton-Chambers.
b Includes 490 Semet-Solvay, 779 Otto-Hoffman, and 66 Wilcox.

In the following table is shown the record of by-product coke ovens, by States, at the close of 1900, 1901, 1902, and 1903:

Record of by-product ovens, by States.

State.	Ovens December 31, 1900.		Ovens December 31, 1901.		Ovens December 31, 1902.		Ovens December 31, 1903.	
	Completed.	Building.	Completed.	Building.	Completed.	Building.	Completed.	Build'ng.
Alabama	120	120	120	120	240	40	240	40
Illinois	0	0	0	0	0	0	0	120
Maryland	0	0	0	200	0	200	200	0
Massachusetts	400	0	400	0	400	0	400	0
Michigan	0	30	30	45	75	60	75	60
Minnesota	0	0	0	0	0	0	0	50
New Jersey	0	100	0	100	100	0	100	0
New York	30	564	30	564	30	574	40	500
Ohio	0	50	50	0	50	60	50	66
Pennsylvania	355	232	355	504	592	412	675	419
Virginia	60	0	60	0	56	0	56	0
West Virginia	120	0	120	0	120	0	120	0
Wisconsin	0	0	0	0	0	0	0	50
Total	1,085	1,096	1,165	1,533	1,663	1,346	1,956	1,335

IMPORTS AND EXPORTS.

The following table gives the quantity and value of coke imported and entered for consumption in the United States from 1869 to 1903, inclusive. In the reports of the Bureau of Statistics of the Department of Commerce and Labor the quantities are given in 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, 1869–1903.

Year ending June 30—	Quantity.	Value.	Year ending Dec. 31—	Quantity.	Value.
	Short tons.			Short tons.	
1869		$2,053	1887	35,820	$100,312
1870		6,388	1888	35,201	107,914
1871		19,528	1889	28,608	88,008
1872	9,575	9,217	1890	20,808	101,767
1873	1,091	1,366	1891	50,753	223,184
1874	634	4,588	1892	27,420	86,350
1875	1,046	9,648	1893	37,183	99,683
1876	2,065	8,657	1894	32,566	70,359
1877	4,068	16,686	1895	29,622	71,366
1878	6,616	24,186	1896	43,372	114,713
1879	6,035	24,748	1897	34,937	98,077
1880	5,047	18,406	1898	46,127	142,384
1881	15,210	64,967	1899	31,197	142,504
1882	14,924	53,244	1900	115,556	371,341
1883	20,634	113,114	1901	72,727	266,075
1884	14,483	36,278	1902	140,488	423,775
1885	20,876	64,814	1903	142,330	437,625
1886	28,124	84,801			

The quantity 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	1900	422,239	$1,358,968
1896	169,189	553,600	1901	430,450	1,561,898
1897	178,034	546,066	1902	439,590	1,785,188
1898	199,562	600,931	1903	466,351	2,091,875
1899	280,196	858,856			

PRODUCTION OF COKE BY STATES.

ALABAMA.

Although coke production in Alabama in 1903 showed a substantial increase, the State being credited with a gain of 141,251 short tons over 1902, it was not sufficient to enable her to retain the position of second in rank which she took from West Virginia. The coking industry of West Virginia in 1902 was somewhat disturbed by labor troubles, and production in that State did not increase in the same proportion as it did in Alabama. In 1903, however, West Virginia's output increased over 190,000 tons, with the result of displacing Alabama and resuming second place by a narrow margin. Alabama produced 2,693,497 tons in 1903, as compared with 2,552,246 tons in 1902.

Notwithstanding the increase of production in 1903, the value fell off $678,310, or from $8,300,838 to $7,622,528, and the average price per ton dropped from $3.25 to $2.83.

The statistics for 1902 show that there were 39 coke-making establishments in Alabama in 1903. One of these having 46 ovens, was idle throughout the entire year, and 3, with a total of 240 ovens, did not begin operations before the end of the year. The total number of ovens operated in the State during 1903 was 8,764, compared with 7,571 in 1902. The number of new ovens building at the close of 1903 was 381, of which 40 were Semet-Solvay ovens. When these 40 are completed there will be a total of 280 retort ovens operating in the State.

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, 1880–1903.

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	976	242	418,184	244,009	609,185	2.50	60
1885	11	1,075	16	507,934	301,180	755,645	2.50	59
1886	14	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	848,606	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	[a] 120	2,451,475	1,443,017	3,094,461	2.14	58.8
1898	25	[b] 5,456	100	2,814,615	1,663,020	3,378,946	2.03	59
1899	25	[b] 5,599	850	3,028,472	1,787,809	3,634,471	2.03	59
1900	30	[b] 6,529	[b] 690	3,582,547	2,110,837	5,629,423	2.667	58.9
1901	31	[b] 7,136	[b] 535	3,849,908	2,148,911	6,062,616	2.82	55.8
1902	37	[c] 7,571	[d] 1,334	4,237,491	2,552,246	8,300,838	3.25	60.2
1903	39	[c] 8,764	[d] 381	4,483,942	2,693,497	7,622,528	2.83	60.0

[a] Semet-Solvay ovens.
[b] Includes 120 Semet-Solvay ovens.
[c] Includes 240 Semet-Solvay ovens.
[d] 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, 1890–1903.

[Short tons.]

Year.	Run of mines. Unwashed.	Run of mines. Washed.	Slack. Unwashed.	Slack. Washed.	Total.
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
1903	1,859,450	602,446	....	2,522,046	4,483,942

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 1903 was washed slack, and of the run-of-mine coal used over 44 per cent was washed.

COLORADO AND UTAH.

As there are but two coke-making establishments 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 combined amounted in 1903 to 1,053,840 short tons, valued at $3,089,783, against 1,003,393 short tons, valued at $2,754,341 in 1902, and 671,303 short tons, valued at $1,626,279, in 1901. The large production during the last two years has been due principally to the increased activity at the works of the Colorado Fuel and Iron Company, the largest coal and iron producer in Colorado. With an increase of three in the number of establishments in the last two years, the number of ovens built has increased nearly 70 per cent, from 2,060 in 1901, to 3,010 in 1902, and to 3,455 in 1903. One of the new establishments is that of the Utah Fuel Company, at Sunnyside, Utah, where 300 new ovens were put in blast in 1903. There were four establishments with a total of 151 ovens in Colorado which did not produce any coke during the year.

All of the coal used for coking purposes in Colorado and Utah during 1903 was slack, and of this about two-thirds was washed before coking. In 1902 all of the coal coked, except 831 tons, was slack coal, 60 per cent of which was washed before being charged into the ovens.

Statistics of the manufacture of coke in Colorado and Utah, 1880–1903.

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
1903 [a]	18	3,455	0	1,776,974	1,053,840	3,089,783	2.93	59.3

[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, 1890–1903.

[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
1903	0	0	594,584	1,182,390	1,776,974

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.

The production of coke in Georgia in 1903 amounted to 85,546 short tons, an increase of 3,482 short tons, or a little more than 4 per cent, over 1902, and the largest production since 1894, when it amounted to a little over 93,000 tons. The value of the product in 1903 showed a much greater proportion of increase than the output. The average price per ton advanced from $3.64 in 1902 to $4.31 in 1903, and the total value increased from $298,963 to $368,351, a gain of $69,388, or 23.2 per cent.

Thirty-eight new ovens were completed in 1903 and 30 old ones were abandoned, making a net gain of 8 in the total number The statistics of the production of coke in Georgia from 1880 to 1903 are shown in the following table:

Statistics of the manufacture of coke in Georgia, 1880–1903.

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	58,673	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
1903	2	500	0	146,086	85,546	368,351	4.306	58.5

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, 1890–1903.

[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
1903	39,750	0	0	106,336	146,086

INDIAN TERRITORY.

One new establishment and 6 new ovens, with a slight gain in production (377 tons) and an advance of 10 per cent in the average price, are the comparisons shown by the records of 1903 and 1902 for Indian Territory. The production in 1903 amounted to 49,818 short tons, as compared with 49,441 tons in 1902. The value of the product increased 12 per cent, from $202,921 to $227,542. Nearly all of the coal used for coking is slack, and most of this is washed before being charged into the ovens. The ovens in the Territory have been built for the purpose of utilizing the slack coal for which there was no market.

The statistics of the manufacture of coke in the Indian Territory from 1880 to 1903 are as follows:

Statistics of the manufacture of coke in the Indian Territory, 1880–1903.

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
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
1903	5	286	0	110,068	49,818	227,542	4.57	45

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, 1890–1903.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
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
1903	331	0	1,295	108,462	110,068

KANSAS.

A small amount of coke is produced in Kansas each year by zinc mining companies for their own use. The coal used is Pittsburg (Kansas) slack, which makes a rather low grade of coke, suitable for use in zinc retorts. The establishments are all small, averaging 10 ovens each. One plant of 6 ovens was abandoned in 1903, reducing the number of establishments to 9 and the number of ovens to 91. Production fell off from 20,902 short tons in 1902 to 14,194 tons in 1903. Four of the 9 establishments were idle during the entire year.

The statistics of the manufacture of coke in Kansas from 1880 to 1903 are as follows:

Statistics of the manufacture of coke in Kansas, 1880–1903.

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	12,498	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	7,853	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
1903	9	91	....	30,503	14,194	50,221	3.54	46.5

KENTUCKY.

Kentucky is the only State in the Union whose coal supplies are drawn from any two of the great fields. The eastern counties of the State are included in the coal measures of the Appalachian field, and a portion of the western part of the State is underlain by the southern extremity of the Central, or Illinois-Indiana field. Coke is made from coal mined in both the eastern and the western counties. The largest coke-producing plant in the State is located in the western coal areas, although little or no coke is made from the coals drawn from the more extended fields of Illinois and Indiana. The entire coking industry of Kentucky, however, is not an important one, and is dependent chiefly upon the utilization of slack coal which would otherwise be wasted. About 22 per cent of the coal used for coking iu 1903 was run-of-mine washed coal. The rest was slack, and the greater part of the slack coal was washed.

One of the 7 establishments in the State was idle throughout the year. This is a new plant, where coal-mining operations have not yet commenced. The total production in 1903 was 115,362 short tons, as compared with 126,879 short tons in 1902.

The statistics of the manufacture of coke in Kentucky from 1880 to 1903 are as follows:

Statistics of the manufacture of coke in Kentucky, 1880–1903.

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	38	....	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	182	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
1903	7	499	0	247,950	115,362	305,327	2.65	46.5

MISSOURI.

The coking industry of Missouri is akin to that of Kansas. There are 2 small coking plants in the State which are operated, like the Kansas ovens, in connection with zinc works, which do not require a high-grade coke. All of the coal used is unwashed slack.

The statistics of the production of coke in Missouri from 1887, when coking began in this State, to 1903 are as follows:

Statistics of the manufacture of coke in Missouri, 1887–1903.

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
1903	2	8	0	3,004	1,839	5,797	3.15	61.2

MONTANA.

Coke making in Montana during 1903 was marked rather by new construction than by anything else. The number of establishments was increased from 3 to 4, and the number of ovens built increased from 410 to 555, while 100 additional new ovens were building at the close of the year. One establishment, having 100 ovens, was idle during the entire year, and the production of the State fell off from 53,463 tons in 1902 to 45,107 tons in 1903. All of the coal used was run-of-mine, nearly all of which was washed before coking.

The statistics of the manufacture of coke in Montana from 1883, when ovens were first reported, to 1903 are as follows:

Statistics of the manufacture of coke in Montana, 1883–1903.

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
1903	4	555	100	82,118	45,107	310,882	6.89	54.9

NEW MEXICO.

New Mexico's coking industry is not an important one, there being but 2 establishments with a total of 126 ovens in the Territory. The production in 1903, all of which was from slack coal, amounted to 11,050 short tons, a decrease of over 50 per cent from that of 1902, and less than one-fourth the production of 1900.

The statistics of the production of coke in New Mexico from 1882, when coke ovens were first reported, until 1903 are as follows:

Statistics of the manufacture of coke in New Mexico, 1882–1903.

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	66
1883	2	12	28	6,941	3,905	21,478	5.50	57
1884	2	70	0	29,990	18,282	91 410	5.00	57
1885	2	70	0	31,889	17,940	89,700	5.00	56
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	118,868	2.84	57.5
1902	2	126	0	40,943	23,296	74,051	3.178	56.9
1903	2	126	0	18,613	11,050	31,539	2.85	59.4

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 of Ohio. Production has been somewhat increased during the last three years as a result of the operations of the Otto-Hoffman by-product ovens built at Hamilton, near Cincinnati, and completed in 1901. The completion of 66 Wilcox ovens at Cleveland will also increase the State's production. These ovens were begun in 1902, and should be put in blast in 1904.

In the following table the statistics of the production of coke in Ohio for the years 1880 to 1903 are consolidated:

Statistics of the manufacture of coke in Ohio, 1880-1903.

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	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
1903	8	[a]440	[b]66	211,473	143,913	528,142	3.67	68

[a] Includes 50 Otto-Hoffman ovens. [b] Wilcox 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. Unwashed.	Run of mine. Washed.	Slack. Unwashed.	Slack. Washed.	Total.
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
1903	174,544	0	9,216	27,713	211,473

PENNSYLVANIA.

Two-thirds of the entire coke product of the United States is made in Pennsylvania, and about 60 per cent of Pennsylvania's production is made in what is known as the famous Connellsville region of that State. If to the production of the Connellsville district proper is added that of the Upper Connellsville and the recently developed "Klondike" or Lower Connellsville fields, this region will be credited with over 80 per cent of the entire production of the State and 50 per cent of the total output of the country.

The coke production of Pennsylvania in 1903 amounted to 15,639,011 short tons, out of a total for the United States of 25,262,360 short tons. In 1902 Pennsylvania produced 16,497,910 short tons, out of a total of 25,401,730 tons. Out of these totals the Connellsville region produced 10,418,366 tons in 1902 and 9,099,100 tons in 1903. If to the production of the Connellsville district proper that of the Lower Connellsville and the Upper Connellsville districts be added, the production of Connellsville coke in 1902 is found to have been 13,274,331 tons, and 12,215,821 tons in 1903.

As compared with 1902, the coke production of Pennsylvania in 1903 exhibits a decrease of 858,899 short tons, or 5.2 per cent. The principal decreases of production were borne by the Connellsville and Upper Connellsville districts, the former decreasing from 10,418,366 in 1902 to 9,099,100 tons in 1903, and the latter from 936,854 to 784,132 tons. Other decreases were shown in the Clearfield-Center, Irwin, and Pittsburg districts. The active developments which have been in progress during the last few years in the Lower Connellsville district are reflected by the increased production in that territory from 1,899,111 tons in 1902 to 2,332,589 tons in 1903. Increases were also shown in the Allegheny Mountain, Broadtop, Greensburg, and Reynoldsville-Walston districts.

Notwithstanding the decrease of 858,899 short tons in production, the value of the product increased from $38,451,722 in 1902 to $38,930,060 in 1903. As has previously been explained, this increase in value was due to the high prices obtained during the first of the year, which in turn were due to the scarcity of coal produced by the anthracite strike in Pennsylvania. The average price of $2.49 obtained for Pennsylvania coke in 1903 was the highest obtained in the history of the industry.

The H. C. Frick Coke Company, the largest coke producer in the United States, whose operations are carried on in the Connellsville region, withdrew from the general market in 1902, with the idea of disposing of its entire production to the furnaces and mills of the United States Steel Corporation, of which the Frick Company is now a subsidiary part. In the latter part of 1903, however, the conditions in the iron industry were such that the steel corporation was not able to consume the entire product of the Frick Company, and the latter organization again entered the open market.

The number of coke-making establishments in Pennsylvania increased from 196 in 1902 to 212 in 1903, a gain of 16. Ten of these new establishments were constructed in the Lower Connellsville district, which, since 1901, has been the second in importance among the coke-producing districts in the State. The total number of ovens increased from 36,609 to 40,092, an increase of 3,483. Of these new ovens 1,342 were built in the Lower Connellsville district. There were building at the close of 1903 1,785 new ovens, of which 586, or nearly one-third, were credited to the Lower Connellsville district. The completed ovens at the end of 1903 included 517 by-product ovens of the Otto-Hoffman type, and 158 ovens of the Semet-Solvay type. The new ovens in course of construction at the close of 1903 included 100 Otto-Hoffman and 319 Semet-Solvay ovens. Of the total number of establishments in the State there were 6 plants, with a total of 205 ovens, which were not operated at all during the year, and 4 others, with a total of 744 ovens, whose establishments were not completed and the ovens in blast before January 1, 1904.

In the following table are given the statistics of the production of coke in Pennsylvania for the years 1880 to 1903, inclusive:

Statistics of the manufacture of coke in Pennsylvania, 1880–1903.

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	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
1903	212	40,092	1,785	23,706,455	15,639,011	38,930,060	2.49	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.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	11,788,625	308,591	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
1896a	9,289,089	273,082	1,463,047	99,392	11,124,610
1897a	11,540,459	301,052	1,441,611	255,524	13,538,646
1898a	14,083,073	350,153	1,472,347	402,268	16,307,841
1899b	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
1903	20,279,281	644,441	1,981,544	801,189	23,706,455

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 Broadtop districts embrace the Blossburg and Broadtop 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 1902, by districts.

District.	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.*
Allegheny Mountain	16	a 1,563	b 380	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	8	d 623	0	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-Solvey ovens.
f Includes 60 Semet-Solvey ovens.
g Otto-Hoffman ovens.
h Includes production of ovens in Allegheny Valley district.
i Includes 120 Otto-Hoffman and 25 Semet-Solvey ovens.
j Semet-Solvey ovens at Chester, in eastern Pennsylvania.
k Schniewind ovens at Lebanon.

Coke production in Pennsylvania in 1903, by districts.

District.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
Allegheny Mountain	16	a2,047	b100	1,116,345	739,263	$2,139,569	$2.89	66.2
Allegheny Valley c	2	51	0	....	....	....	....	....
Broadtop d	5	571	0	351,507	244,898	748,920	3.06	69.6
Clearfield-Center-Elk	8	650	0	260,577	166,355	544,865	3.275	63.8
Connellsville	101	e22,824	f330	13,493,631	9,099,100	20,706,722	2.275	67.4
Greensburg	8	1,332	0	818,216	451,385	1,477,134	3.27	55.5
Irwin	6	691	0	207,067	133,290	334,434	2.51	64.4
Lebanon and Schuylkill	3	g237	h130	....	....	....	....	....
Lower Connellsville	31	5,595	586	3,457,796	2,332,589	5,523,604	2.368	67.4
Pittsburg i	7	j1,585	k359	1,404,660	877,640	2,632,827	3.00	62.5
Reynoldsville-Walston	7	2,003	0	1,420,709	810,359	2,688,472	3.32	57.4
Upper Connellsville	18	2,506	280	1,180,947	784,132	2,133,513	2.72	66.4
Total	212	40,092	1,785	23,706,455	15,639,011	38,930,060	2.49	65.9

a Includes 160 Otto-Hoffman ovens.
b Includes 100 Otto-Hoffman ovens.
c Production included in Pittsburg district.
d Includes production in Lebanon and Schuylkill valleys.
e Includes 80 Semet-Solvay ovens.
f Includes 30 Semet-Solvay ovens.
g Otto-Hoffman ovens.
h Semet-Solvay ovens.
i Includes production of ovens in Allegheny Valley district.
j Includes 120 Otto-Hoffman and 78 Semet-Solvay ovens.
k Includes 159 Semet-Solvay ovens.

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 in Indiana County, east of Blairsville, and also includes a few plants in Somerset County.

The establishments in the vicinity of Johnstown include 160 by-product ovens of the Otto-Hoffman type, which are operated in connection with the Cambria Steel Company of that city. An additional bank of 100 ovens of the same kind has been under consideration for nearly two years, but had not been completed at the close of 1903. The production for the district in 1903 shows a substantial gain over 1902, the output having increased from 644,053 short tons to 739,263 short tons, while the value increased in considerably greater proportion, from $1,782,660 to $2,139,569. The average price per ton advanced from $2.77 in 1902 to $2.89 in 1903. The total number of ovens in the district increased from 1,563 to 2,047, all of which were operated during the year.

The statistics of the manufacture of coke in the Allegheny Mountain district from 1880 to 1903 are as follows:

Statistics of the manufacture of coke in the Allegheny Mountain district of Pennsylvania, 1880–1903.

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	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	284,544	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	61.4
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	1,283	60	271,096	173,965	214,741	1.23	64
1896	13	a1,188	0	408,827	266,473	349,373	1.31	65
1897	13	a1,185	0	417,470	278,578	365,191	1.31	66.7
1898	13	a1,158	b100	572,568	378,410	511,202	1.35	66
1899	13	c1,256	8	730,843	478,340	959,740	2.01	65.5
1900	14	d1,341	0	876,440	557,184	1,260,441	2.26	63.6
1901	16	d1,378	0	864,133	548,076	1,112,682	2.03	63.4
1902	16	d1,563	e380	965,412	644,058	1,782,660	2.768	66.7
1903	16	c2,047	e100	1,116,345	739,263	2,139,569	2.89	66.2

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 Includes 100 Otto-Hoffman ovens.

Broadtop district.—The Broadtop district includes the ovens in Bedford and Huntington counties, which comprise what is known as the Broadtop coal field. There are only 5 establishments in the district, with a total of 571 ovens. There were no new ovens building during the year. The production increased from 175,808 tons in 1902 to 244,898 tons in 1903, the value increasing at the same time from $594,521 to $748,920.

The statistics of the manufacture of coke in the Broadtop district from 1880 to 1003 are shown in the following table:

Statistics of the manufacture of coke in the Broadtop district, Pennsylvania, 1880–1903.

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	5	188	105	92,894	51,130	$123,748	$2.40	55
1881	5	188	105	111,598	66,560	167,074	2.51	59
1882	5	293	50	170,637	105,111	215,079	2.05	62
1883	5	343	110	220,982	147,154	271,692	1.84	66
1884	5	458	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	164,585	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	80,985	124,882	1.543	65.9
1899	5	519	3	161,196	107,258	197,895	1.84	66.5
1900	5	532	0	179,068	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
1903 b	5	571	0	351,507	244,898	748,920	3.06	69.6

a Kloman retort ovens.
b Includes production and value of coke in by-product ovens at Lebanon.

Clearfield-Center district.—This district derives its name from the two principal counties composing it—Clearfield and Center. A few ovens constructed in Elk County during 1901–2 have been added to this district.

The production in 1903 was slightly less than that of the previous years, amounting to 166,355 short tons, as compared with 198,725 short tons in 1902. The value, however, increased from $489,637 to $544,865.

The statistics of the manufacture of coke in the Clearfield-Center district for the years 1880 to 1903 are as follows:

Statistics of the manufacture of coke in the Clearfield-Center district, Pennsylvania, 1880–1903.

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	48,108	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	171,492	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 [a]	8	636	0	134,913	86,242	157,648	1.828	63.9
1902	8	623	0	308,289	198,725	489,637	2.46	64.5
1903	8	650	0	260,577	166,855	544,865	3.275	63.8

[a] Includes ovens and production and value of coke in Elk County since 1901.

Connellsville district.—This district, which produces more coke than any other one region in the world, is located in the two counties of Fayette and Westmoreland, a short distance east of 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.

The Connellsville coal is an ideal fuel for coking in beehive ovens, and all but 50 of the 22,824 ovens built in this district up to the close of 1903 were of the beehive type. Connellsville coke made in beehive ovens is considered by some ironmasters to be without an equal in the world as a blast furnace fuel. The production of the district in 1903 amounted to 9,099,100 short tons, as compared with 10,418,366 short tons in 1902, showing a decrease for the district in 1903 of 1,319,266 short tons. The value decreased from $23,785,433 to $20,706,722, a loss of $3,078,711. The number of establishments in the district increased from 97 in 1902 to 101 in 1903, and the number of ovens from 21,659 to 22,824. There were 330 new ovens building at the close of the year, 110 of which are of the Semet-Solvay type of by-product ovens.

The following are the statistics of the manufacture of coke in the Connellsville region from 1880 to 1903:

Statistics of the manufacture of coke in the Connellsville region, Pennsylvania, 1880–1903.

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	4,301,578	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	1,820	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	7,141,081	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	30	12,174,597	8,181,179	10,122,458	1.237	67.2
1896	38	a18,347	0	8,107,536	5,462,490	10,018,946	1.834	67.4
1897	36	a18,467	92	10,243,690	6,860,826	10,662,428	1.55	67
1898	38	a18,927	20	12,454,969	8,315,350	12,626,292	1.518	66.8
1899	36	a19,294	792	14,974,018	10,390,335	17,075,411	1.64	69.4
1900	98	a20,981	686	14,946,659	10,020,907	22,383,432	2.23	67
1901	96	a21,586	243	15,266,722	10,235,943	19,172,697	1.873	67
1902	97	a21,659	374	15,538,701	10,418,366	23,785,433	2.283	67.05
1903	101	b22,824	c330	13,498,631	9,099,100	20,706,722	2.275	67.4

a Includes 50 Semet-Solvay by-product ovens.
b Includes 80 Semet-Solvay by-product ovens.
c Includes 30 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 and 1903, 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 and 1903, by months.

Month.	1902.			1903.		
	Cars.	Daily average.	Tons.	Cars.	Daily average.	Tons.
January	51,986	1,925	1,173,860	47,626	1,764	1,134,272
February	42,458	1,769	971,048	41,783	1,741	958,961
March	50,386	1,938	1,133,978	53,534	2,059	1,274,863
April	53,411	2,054	1,219,928	55,554	2,137	1,346,063
May	57,523	2,130	1,300,648	53,929	2,074	1,288,550
June	55,294	2,127	1,234,596	56,730	2,182	1,379,257
July	56,858	2,106	1,271,045	55,285	2,048	1,327,239
August	54,889	2,111	1,238,260	51,234	1,970	1,211,826
September	54,659	2,102	1,246,095	51,257	1,970	1,239,365
October	52,917	1,960	1,230,860	42,722	1,582	1,041,966
November	46,250	1,850	1,079,037	27,348	1,094	629,768
December	47,567	1,762	1,039,385	21,736	806	513,187
Total	624,198	1,986	14,138,740	558,738	1,782	13,345,230

The monthly shipments of coke from this region in the years 1897 to 1903, as reported by the Courier, are given in the following table:

Monthly shipments of coke from the Connellsville region in the years 1897–1903.

[Short tons.]

Month.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	485,624	727,739	779,792	1,001,882	989,367	1,173,860	1,134,272
February	466,206	667,287	699,474	910,729	939,756	971,048	958,961
March	521,484	744,987	839,763	1,044,588	1,150,734	1,133,978	1,274,863
April	493,027	701,317	831,964	982,551	1,070,708	1,219,928	1,346,063
May	501,857	680,754	804,023	934,186	1,084,458	1,300,648	1,288,550
June	500,483	636,877	837,123	872,316	1,075,000	1,234,596	1,379,257
July	583,867	646,065	883,735	732,981	1,046,996	1,271,045	1,327,239
August	562,703	662,880	889,078	698,065	1,099,417	1,238,260	1,211,826
September	625,902	644,422	813,190	673,336	1,011,439	1,246,095	1,239,365
October	737,498	731,602	874,357	734,748	1,128,183	1,230,860	1,041,966
November	700,352	844,907	935,608	751,443	1,070,204	1,079,037	629,768
December	736,049	771,275	941,657	829,409	943,687	1,039,385	513,187
Total	6,915,052	8,460,112	10,129,764	10,166,234	12,609,949	14,138,740	13,345,230

These shipments from the Connellsville district, as reported by the Courier, include not only what is designated in this report as the Connellsville district proper, but also the greater part of the production of Upper and Lower Connellsville districts.

The total shipments, in cars, for the last sixteen years were as follows:

Total and daily average shipments, in cars, 1888–1903.

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	523,208
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	1903	1,782	558,738

The following table shows the prices prevailing for Connellsville furnace and foundry coke during the years 1900, 1901, 1902, and 1903. The abnormally high prices reported for both grades of coke in 1902 and 1903 were for coke sold for prompt delivery.

Month.	Furnace.					
	1900.	1901.	1902.		1903.	
			Contract price.	For prompt delivery.	Six months' contracts.	Prompt delivery.
January	$2.75 to $3.50	$1.75	$2.25	$2.50 to $3.50	$3.75 to $4.00	$6.00 to $7.00
February	2.75 to 3.50	1.75	2.25	2.50 to 3.00	3.50 to 4.00	4.50 to 5.50
March	3.25 to 4.25	$1.75 to 2.00	2.25	2.50 to 3.00	3.50 to 4.00	5.00 to 5.50
April	3.25 to 4.25	2.00	$2.25 to 2.50	2.50 to 3.00	3.75 to 4.00	4.50 to 5.00
May	3.00 to 3.25	2.00	2.25 to 2.50	....	3.00 to 3.50	3.50 to 4.00
June	2.50 to 3.00	1.75 to 2.00	2.25 to 2.50	2.50 to 3.50	2.75 to 3.00	2.75 to 3.50
July	2.00 to 2.50	1.75 to 2.00	2.25	3.00 to 4.00	2.50	2.50
August	2.00	1.75 to 2.00	2.25	3.50 to 4.00	2.25 to 2.50	2.00 to 2.50
September	2.00	1.75 to 2.00	3.00	4.00 to 5.00	2.25 to 2.50	2.00 to 2.50
October	2.00	1.75 to 2.00	3.50 to 4.00	8.00 to 12.00	2.00 to 2.10	1.75 to 2.10
November	2.00	1.85 to 2.00	3.50 to 4.00	7.00 to 8.00	....	1.65 to 2.00
December	1.75 to 2.00	2.10 to 2.25	3.75 to 4.00	7.00 to 8.00	....	1.65 to 1.75

Month.	Foundry.				
	1900.	1901.	1902.[a]	1903.[a]	1903.[b]
January	$3.00 to $4.00	$2.00 to $2.25	$2.75 to $3.00	$4.75 to $5.00	$6.00 to $7.50
February	3.00 to 4.00	2.25	2.75 to 3.00	(c)	6.00 to 7.00
March	3.75 to 4.50	2.50	2.75 to 3.00	(c)	6.00 to 7.00
April	3.25 to 4.50	2.50	2.75 to 3.00	5.00	5.50 to 6.00
May	3.00 to 3.50	2.50	2.75 to 3.00	4.00	4.00 to 5.50
June	3.00 to 3.25	2.25 to 2.50	2.75 to 3.00	3.25 to 4.00	3.50 to 4.00
July	2.75 to 3.00	2.25 to 2.50	2.75 to 3.00	3.00 to 3.25	3.00 to 3.50
August	2.75	2.25 to 2.50	2.75 to 3.00	3.00	3.00
September	2.25 to 2.50	2.25 to 2.50	4.00 to 4.50	2.75 to 3.00	2.75 to 3.00
October	2.25 to 2.50	2.25 to 2.50	4.50 to 5.00	2.75 to 3.00	2.75 to 3.00
November	2.25 to 2.50	2.25 to 2.50	4.50 to 5.00	....	2.50 to 2.65
December	2.25 to 2.50	2.35 to 2.50	4.50 to 5.00	....	2.15 to 2.50

a Contract prices. b Prompt delivery. c No contract prices quoted.

As shown above, the reaction from the abnormally high prices in the latter part of 1902 and the first four months of 1903 was sharp and decided. Stimulated by the almost frantic demands for coke which were created by the strike in the anthracite fields of Pennsylvania, production was pushed to the utmost, many plants being put in blast that had been idle for several years. New ovens were fired as soon as they were completed, each producer doing his utmost to get the greatest benefit possible out of the prevailing high prices. The results were only what might have reasonably been expected. By the early summer of 1903 production had caught up with the demand, and having caught up it made the slight step to oversupply, with the usual slump in prices. Quotations fell off rapidly and continuously from May until December, when the lowest figures in four years were reached for both furnace and foundry cokes in the Connellsville district. An attempt at combination and maintaining of prices was made by a number of independent operators in the Connellsville region during October and November, but any benefit to the trade in general was not apparent.

Greensburg district.—This district continues to grow in importance, production having increased steadily since 1894. The developments in the last five years have been particularly noticeable. Production in 1903 amounted to 451,385 short tons, an increase of 9,444 tons over 1902. The number of establishments increased from 7 to 8, and the total number of ovens from 1,240 to 1,332. No new ovens under construction were reported for this district at the close of 1903.

Statistics of the manufacture of coke in the Greensburg district, Pennsylvania, 1889–1903.

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
1903	8	1,332	0	813,216	451,385	1,477,134	3.27	55.5

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. The district is not an important one, and it does not appear as if much were to be expected of it in the near future. Production in 1903 was slightly less than in the preceding year, the number of establishments and of ovens remaining the same.

Statistics of the manufacture of coke in the Irwin district, Pennsylvania, 1889–1903.

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.*
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
1903	6	691	0	207,067	133,290	334,434	2.51	64.4

Lower Connellsville district.—Although only four years old, this district holds second place among the coke-producing districts of Pennsylvania, and in 1903 contributed 35 per cent of the coke production of the State outside of Connellsville. This district, which was originally known as the "Klondike," is an extension to the southwest of the Connellsville basin and includes the developments in and around the city of Uniontown. Although production in the Connellsville district proper fell off over 1,300,000 tons in 1903, the output of the Lower Connellsville district increased 433,478 short tons, or nearly 23 per cent, over 1902. The number of establishments increased 50 per cent, from 21 to 31, and the number of ovens built from 4,253 to 5,595. There were 586 new ovens in course of construction at the close of 1903.

The record of the district for the four years during which it has been in existence is shown in the following table:

Statistics of the manufacture of coke in the Lower Connellsville district in 1900, 1901, 1902, and 1903.

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
1903	31	5,595	586	3,457,796	2,332,589	5,523,604	2.368	67.4

Lebanon Valley and Schuylkill districts.—The plant of 237 Otto-Hoffman ovens at Lebanon, mention of which was made in the report for 1902, was put in blast late in 1903, producnig 40,767 tons of coke. The plant can not be considered, however, as having been in full operation. At the close of 1903 there were 90 Semet-Solvay ovens in course of construction at the same place, and 40 more of the same type which were begun in 1902 at Chester were still unfinished at the end of the year.

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 decreased from 953,863 tons in 1902 to 877,640 tons in 1903, while the value increased from $1,924,942 to $2,632,827. There was a reduction of 1 in the number of establishments and an increase of 25 in the number of ovens. There were 359 new ovens under construction at the close of the year. Of these new ovens, 159 were of the Otto-Hoffman by-product recovery type.

Statistics of the manufacture of coke in the Pittsburg district, Pennsylvania, 1880–1903.

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	588	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	585	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 1,238	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
1903 g	h 9	i 1,636	j 359	1,404,660	877,640	2,632,827	3.00	62.5

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.
i Includes 173 Otto-Hoffman and 25 Semet-Solvay ovens.
j Includes 159 Otto-Hoffman ovens.

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 1903 amounted to 810,359 short tons, valued at $2,688,472, as compared with 689,890 short tons, valued at $1,422,143, in 1902.

The following are the statistics of the manufacture of coke in the Reynoldsville-Walston district for the years 1880 to 1903:

Statistics of the manufacture of coke in the Reynoldsville-Walston district, Pennsylvania, 1880–1903.

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	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
1903	7	2,003	0	1,420,709	810,359	2,688,472	3.32	57.4

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 1903 amounted to 784,132 short tons, as compared with 936,854 short tons in 1902. Owing to the high prices for coke in the early part of 1903, the value decreased much less in proportion, from $2,193,332 to $2,133,513.

Statistics of the manufacture of coke in the Upper Connellsville district, Pennsylvania, 1880–1903.

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	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	649,816	1,111,056	1.71	65
1892	14	1,843	0	706,171	451,975	691,823	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
1903	18	2,506	280	1,180,947	784,132	2,133,513	2.72	66.4

TENNESSEE.

Tennessee ranks sixth among all the coke-producing States and third among those classed as southern States. The product is for the most part consumed in the iron furnaces at Chattanooga and vicinity and other points in the eastern part of the State. There was a slight decrease in production in 1903 as compared with 1902, the output declining from 560,006 short tons to 546,875 short tons. The production last year was, however, larger than in any preceding year except 1902, while the value exceeded all previous records. The average price obtained for all coke sold in 1903 was $3.12, against $2.85 in 1902. The total value increased from $1,597,041 to $1,706,722.

There was a gain of 1 in the number of establishments and of 170 in the number of ovens completed. The new plant added to the list in 1903 was that of the Bon Air Coal and Iron Company, at Bon Air. These ovens (200 in number) did not, however, begin operations until after the close of the year. In addition to this new plant, 104 new ovens were under construction at other establishments, making a total of 304 ovens building at the close of 1902.

The following are the statistics of the manufacture of coke in Tennessee for the years 1880 to 1903.

Statistics of the manufacture of coke in Tennessee, 1880–1903.

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	65	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	364,318	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
1903	16	2,439	304	1,001,356	546,875	1,706,722	3.12	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, 1890–1903.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
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	340,296	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
1903	157,717	404,949	74,560	364,130	1,001,356

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 rapid development of the coking coal fields of southwest Virginia during the last few years has made that Commonwealth prominent among the coke-producing States. Until 1895 there were only two coke-making establishments in the State, and the production had not reached as high as 200,000 tons in any one year. In 1901 the number of establishments had increased to 7, the total number of ovens had increased from 832 (in 1896) to 2,775, and the production exceeded 900,000 short tons. During 1902 construction and development work was pushed rapidly, the number of establishments was doubled, and at the close of the year there were 2,974 ovens built and 1,208 were building, while the production increased to 1,124,572 short tons. In 1903, 2 more were added to the number of plants, making a total of 16; the number of completed ovens was increased to 4,251, with a further increase in the production to 1,176,439. The value of the product in 1903 was $2,724,047, as compared with $2,322,228 in 1902, a gain of $401,819, or 17 per cent as compared with an increase of 4.6 per cent in quantity.

Practically all of the new work in the last two or three years has been carried on in Wise County, on the Clinch Valley branch of the Norfolk and Western Railroad. The coke made in this district is the only coke made in Virginia from coal mined exclusively in the State. There are two plants in Virginia, one at Lowmoor and one at Covington, the coal for which is drawn from mines in the New River district of West Virginia. The coal for the ovens at Pocahontas, in Tazewell County, is obtained from mines whose workings extend across the State boundary line into West Virginia. The openings to the mines, however, and the coke ovens are in Tazewell County, Va., and it is customary to credit the coal as well as the coke to Virginia.

One of the new establishments added to the list in 1904 did not produce any coke in 1903, none of the ovens, 200 in number, having been put in blast before January 1, 1904.

The following are the statistics of the manufacture of coke in Virginia from 1883 to 1903:

Statistics of the manufacture of coke in Virginia, 1883–1903.

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.*
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	a1,564	0	852,972	531,161	699,781	1.317	62
1899	6	a1,588	429	994,635	618,707	1,071,284	1.73	62.2
1900	7	a2,331	300	1,083,827	685,156	1,464,556	2.137	63.2
1901	7	a2,775	0	1,400,231	907,130	1,483,670	1.635	64.7
1902	14	a2,974	1,208	1,716,110	1,124,572	2,322,228	2.065	65.5
1903	16	a4,251	142	1,860,225	1,176,439	2,724,047	2.315	63.2

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, 1890–1903.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
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
1903	857,332	0	1,002,893	0	1,860,225

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 6 establishments in the State at the close of 1903, an increase of 1 over 1902. Three of the 6 plants were idle, however, throughout the whole of 1903. These 3 idle plants included altogether 71 ovens. The 3 plants which made coke included 185 ovens. Production in the State increased from 40,305 short tons in 1902 to 45,623 tons in 1903, while the value increased from $199,195 to $214,776. The largest production obtained in the State was in 1901, when the output amounted to 49,197 short tons, valued at $239,028.

There were no new ovens building at the close of 1903.

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, 1884–1903.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coal 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.*
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
1903	6	256	0	73,119	45,623	214,776	4.71	62.4

WEST VIRGINIA.

By an increase of nearly 200,000 tons in the production of coke in 1903, as compared with the preceding year, West Virginia regained second place among the coke-producing States. Strikes among the coal miners in the New and Kanawha river districts during 1902 retarded somewhat the coke-oven operations, and although production increased over 1901 the increase was less than it would have been except for the labor troubles and allowed Alabama to displace West Virginia as second in coke-producing importance. The return to more peaceful conditions in 1903 is exhibited in an increase from 2,516,505 short tons in 1902 to 2,707,818 short tons, a gain of 191,313 tons, or 7.6 per cent. The value of the product increased from $5,833,226 to $7,115,842, a gain of $1,282,616, or 22 per cent. The number of establishments increased from 120 to 136, and the total number of completed ovens from 12,656 to 15,613. Of the total number of establishments there were 13, having 712 ovens, that were idle throughout the year, and 5, with a total of 957 ovens partly completed, but none of which had been put in blast before the close of the year.

The following table exhibits the statistics of coke production in West Virginia since 1880:

Statistics of the manufacture of coke in West Virginia, 1880–1903.

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	681	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
1903	136	15,613	2,687	4,347,160	2,707,818	7,115,842	2.628	62.3

[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 (73 per cent in 1903) of the coal used in coke making in West Virginia is slack, and of this slack coal 90 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
1903	1,149,761	3,000	2,890,310	304,089	4,347,160

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. Since 1900 the statistics of production of the Flat Top district have included the new operations along Tug River, lying west of and contiguous to the Flat Top district. The output from this district averages something over 50 per cent of the total coke product of the State, although its proportion in 1902 and 1903 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 1903 increased in the Flat Top, the Kanawha, and the New River regions, and decreased 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 1902, by districts.

District.	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.*
Flat Top[a]	44	6,940	1,741	1,781,136	1,109,208	$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 Tug River district. [b] Includes 120 Semet-Solvay ovens.

Production of coke in West Virginia in 1903, by districts.

District.	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.*
Flat Top[a]	51	8,994	1,829	2,094,127	1,314,758	$3,126,512	$2.38	62.8
Kanawha	13	967	321	296,552	179,988	567,308	3.15	60.7
New River	28	2,243	500	619,230	368,844	1,129,701	3.06	59.5
Upper Monongahela	37	[b]2,319	337	724,915	437,522	1,315,336	3.01	60.3
Upper Potomac and Tygarts Valley	7	1,090	200	612,336	406,706	976,985	2.40	66.4
Total	136	15,613	2,687	4,347,160	2,707,818	7,115,842	2.628	62.3

[a] Includes Tug River district. [b] Includes 120 Semet-Solvay ovens.

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, including that of the ovens along Tug River, in 1903 was the largest in its history. 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, 1886–1903.

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.*
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	571,289	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	42	6,049	918	1,899,366	1,160,856	1,893,581	1.63	61.1
1902	44	6,940	1,741	1,781,136	1,109,203	2,189,607	1.974	62.8
1903	51	8,994	1,329	2,094,127	1,314,758	3,126,512	2.38	62.8

a Includes establishments in the Tug River district since 1900.

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 1903, while not as large as in 1901, shows an increase of over 50,000 tons as compared with 1902.

The statistics of the manufacture of coke in the New River district from 1880 to 1903 are as follows:

Statistics of the manufacture of coke in the New River district, West Virginia, 1880–1903.

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	$289,977	$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	1,069	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	519,987	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
1903	28	2,243	500	619,230	368,844	1,129,701	3.06	59.5

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 decreased each year from 1899 to 1902, but increased decidedly in 1903, almost reaching the record of 1899. New construction work was quite active in the district in 1903, as shown by the increase in the number of completed ovens and the comparatively large number building.

The statistics of the manufacture of coke in the Kanawha district from 1880 to 1903 are as follows:

Statistics of the manufacture of coke in the Kanawha district, West Virginia, 1880–1903.

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	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	136	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	54,829	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
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
1903	13	967	321	296,552	179,988	567,308	3.15	60.7

Upper Monongahela district.—This district embraces coke ovens in the counties of Harrison, Marion, and Taylor, and derives its name from the fact that the region is drained by the headwaters of the Monongahela River. It includes the well-known mining regions in the vicinity of Clarksburg and Fairmont, which are among the most important in the State. The production for the district in 1903 decreased 100,000 tons, or 20 per cent, as compared with 1902; but there was a considerable amount of new construction work carried on, which will probably be shown in an increased production for 1904. The number of establishments increased from 31 in 1902 to 37 in 1903, and the number of ovens built increased from 1,698 to 2,319. There were 337 new ovens under construction at the end of the year. There were 341 ovens included in the ovens built which produced no coke in 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, 1880–1903.

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
1903	37	2,319	337	724,915	437,522	1,315,336	3.01	60.3

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 Upper Potomac district includes the ovens along the line of the West Virginia Central and Pittsburg Railroad in the region drained by the upper waters of the Potomac River. The statistics for 1902 and 1903 include also the operations of some new ovens in the Tygarts Valley just across the Ohio-Potomac divide, but practically continuous with the Upper Potomac district. The production for the district in 1903 was slightly less than that of the preceding year, amounting to 406,706 short tons, against 412,077 short tons in 1902. The value, however, increased from $689,718 to $976,985, a gain of $287,267, or 42 per cent. One hundred new ovens were added to the district in 1903, the number of establishments remaining the same as in 1902.

The statistics of the manufacture of coke in the Upper Potomac district (including that of Tygarts Valley in 1902 and 1903) from 1887 to 1903 are shown in the following table:

Statistics of the manufacture of coke in the Upper Potomac and Tygarts Valley district, of West Virginia, 1887–1903.

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.*
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	242,133	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
1903	7	1,090	200	612,336	406,706	976,985	2.40	66.4

OTHER STATES.

In the following table are presented the statistics of production in 1900, 1901, 1902, and 1903 of those States in which there are but one or two establishments. These States are Illinois, Indiana, Maryland, Massachusetts, Michigan, New Jersey, New York, Wisconsin, and Wyoming.

Of the several States included in this statement, five of them—Maryland, Michigan, New Jersey, New York, and Wisconsin—produced coke made from coal mined in other States, while one—Massachusetts—obtains its coal supply partly from Nova Scotia and partly from West Virginia. All of the ovens in Maryland, Massachusetts, New Jersey, New York, and Michigan are by-product retort ovens. The statistics of production for Illinois, Wisconsin, and Wyoming for years previous to 1900 may be found by reference to preceding volumes of Mineral Resources.

Statistics of coke production in 1900, 1901, 1902, and 1903 in States having only one or two establishments.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Valve of coke at ovens per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1900	10	a 832	b 594	708,295	506,730	$1,454,029	$2.87	71.5
1901	11	c 862	d 609	793,187	564,191	1,607,476	2.849	71
1902	11	e 898	f 742	852,977	598,869	2,063,894	3.446	70.2
1903	17	g 1,308	h 760	1,306,707	932,428	3,228,064	3.46	71.3

a Includes 30 Semet-Solvay and 400 Otto-Hoffman ovens.
b Includes 30 Semet-Solvay and 564 Otto-Hoffman ovens.
c Includes 60 Semet-Solvay and 400 Otto-Hoffman ovens.
d Includes 30 Semet-Solvay, 564 Otto-Hoffman, and 15 Schniewind ovens.
e Includes 90 Semet-Solvay, 400 Otto-Hoffman, and 15 Schniewind ovens.
f Includes 70 Semet-Solvay and 564 Otto-Hoffman ovens.
g Includes 100 Semet-Solvay, 700 Otto-Hoffman, and 15 Schniewind ovens.
h Includes 290 Semet-Solvay and 470 Otto-Hoffman ovens.

GAS, COKE, TAR, AND AMMONIA.[a]

By Edward W. Parker.

INTRODUCTION.

Ten years prior to the period covered by this report, or in 1893, the first plant of by-product coke ovens in the United States was completed at Syracuse, N. Y. This plant, although largely of an experimental character and composed of only 12 Semet-Solvay ovens, was successful from the beginning, and laid the foundation for the development of what has since become an important branch of the coke-making industry of this country. The rapid growth of the manufacture of coke in by-product ovens is demonstrated by the fact that in 1903 there were 1,956 of this type of oven in operation, with 1,335 more in process of construction at the close of the year. The quantity of coke produced in by-product ovens during 1903 was 1,882,394 short tons, or 7.4 per cent of the total coke product of the United States.

In the development of this industry the profitable disposition of by-products obtained is an essential factor. A study of the conditions upon which this depends has created a demand for information, not only as to the total quantity and value of coke produced, but also the quantity and value of the gas, tar, and ammonia produced at gas houses and at by-product recovery coking plants. In order to meet this demand the United States Geological Survey, in making its annual canvass of the coal-mining and coke-making industries for the last two years, has extended its inquiries to cover all plants producing gas and coke from coal with the recovery of the tar and ammonia. The completeness of the returns in both years has been particularly gratifying. A similar investigation was made for this office in 1898 by Dr. William B. Phillips, at which time reports 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, while in 1903 reports were received from 528 companies, a decrease of 5 as compared with 1902. In 1902 the 533 companies from

[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.

which reports were received used a total of 5,008,761 short tons of bituminous coal. This included coal carbonized in 1,663 by-product coke ovens. In 1903, including the operations of 1,956 by-product coke ovens, the total amount of coal carbonized was 5,843,538 short tons. In 1898, including the quantity of coal consumed in 520 by-product ovens, the total quantity of coal carbonized was 2,444,995 short tons. The production of gas by the 533 companies in 1902 was 30,764,625,332 cubic feet. Of this quantity 29,079,073,555 cubic feet were sold, leaving 1,685,551,777 cubic feet lost or unaccounted for. In 1903 the 528 companies produced 33,483,430,989 cubic feet of gas, of which 2,433,969,478 cubic feet were lost or unaccounted for and 31,049,461,511 cubic feet were sold.

The total quantity of coke produced at gas works and retort coke ovens in 1902 was 3,373,294 short tons, of which 1,399,119 short tons were produced in by-product coke ovens, leaving 1,974,175 short tons as the output from gas works. In 1903 the total production of coke amounted to 3,941,282 short tons, of which 1,882,394 short tons were obtained from by-product coke ovens, and 2,058,888 short tons produced at gas works. The production of tar in 1902 amounted to 53,099,508 gallons, and in 1903 it was 62,964,393 gallons. The production of ammonia, reduced to its equivalent in sulphate, amounted, in 1903, to 79,747,217 pounds, as compared with 69,115,667 pounds of ammonia, reduced to its equivalent in sulphate, in 1902.

PRODUCTION OF GAS.

The following tables show the quantity and value of gas made from coal by 533 companies in 1902 and 528 companies in 1903, distributed over 44 States and Territories. It will be observed that prices for artificial gas are low in those States where natural gas is used largely and which are in addition well supplied with coal, as in Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia, and also in Massachusetts, where a large portion of the coal 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	237,231,800	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	9,080	76,820,600	47,510,900	87,594	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	277,081	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	1.00	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	13,508	138,402,500	89,549,125	90,849	1.014	48,853,375	49,528	1.018	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	91,684	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	68,798	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	658,765	1.314	109,866,833	139,677	1.27	607,301,433	798,442	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

a Includes coal coked in by-product coke 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—Continued.

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.*
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	34,213,602
New York	57	a 602,321	5,185,539,256	4,602,635,000	4,931,782	1.071	369,600,850	403,349	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	46,484	1.806	7,732,800	10,456	1.352	33,469,500	56,940	1.70	6,751,400
South Carolina	3	11,630	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	6,156	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	71,272,034	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	79,547,831	145,046	1.823	47,942,069	69,433	1.448	127,489,900	214,479	1.682	14,925,700
Virginia	11	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	38,749,737
Washington	7	27,067	233,982,873	165,791,385	280,693	1.69	48,164,065	74,167	1.54	213,955,450	354,860	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	5,008,761	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.

Quantity and value of gas produced and sold at by-product coke plants and coal-gas works of United States in 1903, 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	a576,480	225,590,900	122,409,000	$168,607	$1.38	70,387,000	$77,889	$1.11	192,796,000	$246,496	$1.27	32,794,900
Arkansas	5	10,555	97,368,900	55,272,200	100,260	1.81	39,077,600	58,180	1.48	94,349,800	158,440	1.68	3,019,100
California	3	2,808	41,897,000	26,424,714	54,333	2.05	15,472,286	31,072	2.01	41,897,000	85,405	2.03	....
Colorado	5	48,116	501,889,600	204,758,100	282,855	1.38	256,806,000	257,414	1.00	461,564,100	540,269	1.17	40,325,500
Connecticut	9	60,976	575,000,600	392,192,960	472,138	1.20	150,381,950	171,045	1.14	542,574,910	643,183	1.19	32,425,690
Delaware	3	13,727	124,368,500	70,463,840	70,644	1.00	43,904,660	42,460	.96	114,368,500	113,104	.99	10,000,000
Georgia	9	46,314	389,856,600	209,661,350	249,318	1.19	179,079,300	186,628	1.04	388,740,650	435,946	1.12	1,115,950
Illinois	45	180,212	1,625,661,468	865,919,598	1,012,130	1.17	622,825,727	680,011	1.09	1,488,745,325	1,692,141	1.17	136,916,143
Indiana	30	95,791	838,885,270	517,538,530	531,010	1.02	266,300,400	263,429	.95	783,838,930	794,439	1.01	55,046,340
Iowa	16	45,606	415,761,100	198,934,840	274,111	1.38	170,213,300	205,053	1.21	369,148,140	479,164	1.29	46,612,960
Kansas	11	27,968	241,165,280	109,761,350	162,719	1.48	115,259,150	145,882	1.26	225,020,500	308,601	1.37	16,144,780
Kentucky	11	76,197	661,578,820	403,475,674	408,042	1.01	194,608,000	158,420	.81	598,083,674	566,462	.94	63,495,146
Louisiana and Mississippi	3	3,420	28,500,000	18,725,000	31,340	1.67	9,775,000	11,191	1.14	28,500,000	42,531	1.49	....
Maine	7	17,919	175,318,610	121,894,340	180,041	1.47	39,262,233	53,855	1.34	161,156,573	233,896	1.45	14,162,037
Maryland and District of Columbia	9	a299,326	491,166,360	471,838,723	507,844	1.08	12,073,816	13,219	1.09	483,912,539	521,063	1.07	7,253,821
Massachusetts	45	a862,114	4,847,936,380	4,104,266,970	2,753,397	.67	521,427,765	579,480	1.11	4,625,694,735	3,332,877	.72	222,241,645
Michigan	37	a350,664	2,125,030,500	1,149,952,230	886,828	.77	900,796,370	828,392	.91	2,050,748,600	1,715,220	.83	74,281,900
Minnesota	5	64,322	622,866,085	361,887,200	456,137	1.26	198,256,800	240,305	1.21	560,144,000	696,442	1.24	62,722,085
Missouri	21	199,416	1,808,736,720	897,653,794	937,838	1.04	656,459,390	555,201	.84	1,554,113,184	1,493,039	.96	254,623,536
Montana, New Mexico, and Nevada	5	7,002	62,723,400	31,231,010	56,595	1.81	25,474,390	42,163	1.65	56,705,400	98,758	1.74	6,018,000
Nebraska	3	5,577	50,118,500	29,125,700	45,639	1.57	15,571,100	20,021	1.28	44,696,800	65,660	1.47	5,421,700
New Hampshire and Vermont	7	22,268	214,237,200	153,728,800	208,815	1.36	47,048,700	64,606	1.37	200,777,500	273,421	1.36	13,459,700

a Includes coal coked in by-product coke ovens.

Quantity and value of gas produced and sold at by-product coke plants and coal-gas works of United States in 1903, by States—Continued.

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.*
New Jersey	15	*a* 225,565	1,115,839,705	845,618,505	$922,485	$1.09	230,768,864	$252,774	$1.09	1,076,387,369	$1,175,259	$1.09	39,452,336
New York	56	*a* 638,285	5,516,317,012	4,488,446,614	4,649,533	1.04	663,992,445	702,454	1.05	5,152,439,059	5,351,987	1.04	363,907,953
North Carolina	6	6,332	56,702,000	38,939,810	67,382	1.73	12,732,990	17,052	1.34	51,672,800	84,434	1.63	5,029,200
South Carolina	3	12,320	115,420,000	66,508,100	97,277	1.46	29,368,800	36,043	1.23	95,876,900	133,320	1.39	19,543,100
North Dakota, Utah, and Wyoming	3	6,656	62,053,200	27,155,000	48,451	1.78	24,343,000	33,590	1.38	51,498,000	82,041	1.60	10,555,200
Ohio	48	*a* 516,367	4,599,937,460	3,009,925,952	2,396,846	.79	1,194,632,994	804,423	.67	4,204,558,946	3,201,269	.76	395,378,514
Oregon	4	6,221	51,226,800	25,668,200	50,189	1.95	24,404,200	39,176	1.60	50,072,400	89,365	1.78	1,154,400
Pennsylvania	31	*a* 818,113	2,332,091,700	2,047,163,302	2,096,406	1.02	138,527,177	81,537	.58	2,185,690,479	2,177,943	.99	146,401,221
Rhode Island	3	54,477	572,312,000	357,176,200	427,660	1.19	180,058,000	203,122	1.13	537,234,200	630,782	1.17	35,077,800
Tennessee	8	71,005	627,992,512	335,988,786	361,725	1.07	191,274,426	197,423	1.03	527,263,212	559,148	1.06	100,729,300
Texas	8	15,653	139,400,000	75,515,000	132,545	1.75	56,095,100	73,404	1.31	131,610,100	205,949	1.56	7,789,900
Virginia	14	*a* 55,723	399,926,480	277,857,260	325,342	1.16	61,438,826	64,374	1.04	339,296,086	389,716	1.15	60,630,394
Washington	7	31,447	297,275,627	161,425,925	251,425	1.55	116,553,775	178,568	1.53	277,979,700	429,993	1.54	19,295,927
West Virginia	6	*a* 208,677	177,444,000	133,779,300	106,850	.80	10,188,700	9,142	.89	143,968,000	115,992	.80	33,476,000
Wisconsin	16	129,916	1,253,804,700	545,508,560	578,347	1.06	610,828,840	573,674	.93	1,156,337,400	1,152,021	.99	97,467,300
Total	528	*a* 5,843,538	33,483,430,989	22,953,792,437	22,363,104	.97	8,095,669,074	7,952,672	.98	31,049,461,511	30,315,776	.97	2,433,969,478

a Includes coal coked in by-product coke ovens.

Of the total quantity 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 was 29,079,073,555 cubic feet, of which 23,401,318,526 cubic feet, or 80.45 per cent, were sold for illuminating purposes, and 5,677,755,029 cubic feet, or 19.55 per cent, were sold for fuel. The total value of all gas sold was $29,342,881, an average of $1.009 per 1,000 cubic feet. In 1903 the amount of gas lost by leakage or accident amounted to 2,433,969,478 cubic feet. The total quantity sold was 31,049,461,511 cubic feet, of which 22,953,792,437 cubic feet, or 73.9 per cent, were sold for illuminating purposes, and 8,095,669,074 cubic feet, or 26.1 per cent, were sold for fuel purposes. The average price per 1,000 cubic feet for all gas sold in 1903 was 97 cents. While there are some exceptions to the general rule, the gas sold for illuminating purposes brings as a usual thing a higher price than that sold for fuel purposes.

The following tables show 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 in 1902 and 1903. It will be observed that the percentage of illuminating gas decreased from 80.45 in 1902 to 75 per cent in 1903, while the percentage of fuel gas increased from 19.55 to 25 per cent.

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	37.96
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
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

Quantity of illuminating and fuel gas sold in 1903, by States.

State.	Total sales.	Illuminating.		Fuel.	
		Quantity.	Percentage.	Quantity.	Percentage.
	Cubic feet.	*Cubic feet.*		*Cubic feet.*	
Alabama	192,796,000	122,409,000	64	70,387,000	36
Arkansas	94,349,800	55,272,200	59	39,077,600	41
California	41,897,000	26,424,714	64	15,472,286	36
Colorado	461,564,100	204,758,100	45	256,806,000	55
Connecticut	542,574,910	392,192,960	73	150,381,950	27
Delaware	114,368,500	70,463,840	39	43,904,660	61
Georgia	388,740,650	209,661,350	54	179,079,300	46
Illinois	1,488,745,325	865,919,598	58	622,825,727	42
Indiana	783,838,930	517,538,530	66	266,300,400	34
Iowa	369,148,140	198,934,840	54	170,213,300	46
Kansas	225,020,500	109,761,350	48	115,259,150	52
Kentucky	598,083,674	403,475,674	67	194,608,000	33
Louisiana and Mississippi	28,500,000	18,725,000	66	9,775,000	34
Maine	161,156,573	121,894,340	76	39,262,233	24
Maryland and District of Columbia	483,912,539	471,838,723	98	12,073,816	2
Massachusetts	4,625,694,735	4,104,266,970	89	521,427,765	11
Michigan	2,050,748,600	1,149,952,230	56	900,796,370	44
Minnesota	560,144,000	361,887,200	65	198,256,800	35
Missouri	1,554,113,184	897,653,794	58	656,459,390	42
Montana, New Mexico, and Nevada	56,705,400	31,231,010	55	25,474,390	45
Nebraska	44,696,800	29,125,700	65	15,571,100	35
New Hampshire and Vermont	200,777,500	153,728,800	77	47,048,700	23
New Jersey	1,076,387,369	845,618,505	79	230,768,864	21
New York	5,152,439,059	4,488,446,614	87	663,992,445	13
North Carolina	51,672,800	38,939,810	76	12,732,990	24
South Carolina	95,876,900	66,508,100	69	29,368,800	31
North Dakota, Utah, and Wyoming	51,498,000	27,155,000	53	24,343,000	47
Ohio	4,204,558,946	3,009,925,952	72	1,194,632,994	28
Oregon	50,072,400	25,668,200	54	24,404,200	46
Pennsylvania	2,185,690,479	2,047,163,302	94	138,527,177	6
Rhode Island	587,234,200	357,176,200	67	180,058,000	33
Tennessee	527,263,212	335,988,786	64	191,274,426	36
Texas	131,610,100	75,515,000	58	56,095,100	42
Virginia	339,296,086	277,857,260	82	61,438,826	18
Washington	277,979,700	161,425,925	58	116,553,775	42
West Virginia	143,968,000	133,779,300	93	10,188,700	7
Wisconsin	1,156,337,400	545,508,560	48	610,828,840	52
Total	31,049,461,511	22,953,792,437	75	8,095,669,074	25

In the following tables the States are arranged according to rank in the quantity of gas produced from coal in 1902 and 1903. New York stands first, with a production of 5,516,347,012 cubic feet in 1903; Massachusetts second, with 4,847,936,380 cubic feet; Ohio third, with 4,599,937,460 cubic feet; Pennsylvania, doubtless because of the large amount of natural gas produced in that State, ranks fourth in the production of artificial gas, with 2,332,091,700 cubic feet, or but little more than half of that of Ohio, and only slightly greater than

Michigan, which stands fifth, with 2,125,030,500 cubic feet. Missouri and Illinois, which in 1902 outranked Michigan, took sixth and seventh places, respectively, in 1903, the former producing 1,808,736,720 cubic feet and the latter 1,625,661,468 cubic feet. The only other States which produced as much as 1,000,000,000 cubic feet a year were Wisconsin and New Jersey.

Rank of States in gas production and the quantity sold and unaccounted for in 1902, by States.

Rank.	State.	Total production.	Gas sold. Quantity.	Gas sold. Per cent.	Gas unaccounted for. Quantity.	Gas unaccounted for. 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	5.48

Rank of States in gas production and the quantity sold and unaccounted for in 1903, 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	5,516,347,012	5,152,439,059	93	363,907,953	7
2	Massachusetts	4,847,936,380	4,625,694,735	95	222,241,645	5
3	Ohio	4,599,937,460	4,204,558,946	91	395,378,514	9
4	Pennsylvania	2,332,091,700	2,185,690,479	93	146,401,221	7
5	Michigan	2,125,030,500	2,050,748,600	92	74,281,900	8
6	Missouri	1,808,736,720	1,554,113,184	86	254,623,536	14
7	Illinois	1,625,661,468	1,488,745,325	91	136,916,143	9
8	Wisconsin	1,253,804,700	1,156,337,400	92	97,467,300	8
9	New Jersey	1,115,839,705	1,076,387,369	96	39,452,336	4
10	Indiana	838,885,270	783,838,930	93	55,046,340	7
11	Kentucky	661,578,820	598,083,674	90	63,495,146	10
12	Tennessee	627,992,512	527,263,212	84	100,729,300	16
13	Minnesota	622,866,085	560,144,000	90	62,722,085	10
14	Connecticut	575,000,600	542,574,910	94	32,425,690	6
15	Rhode Island	572,312,000	537,234,200	94	35,077,800	6
16	Colorado	501,889,600	461,564,100	92	40,325,500	8
17	Maryland and District of Columbia	491,166,360	483,912,539	98	7,253,821	2
18	Iowa	415,761,100	369,148,140	88	46,612,960	12
19	Virginia	399,926,480	339,296,086	85	60,630,394	15
20	Georgia	389,856,600	388,740,650	99	1,115,950	1
21	Washington	297,275,627	277,979,700	93	19,295,927	7
22	Kansas	241,165,280	225,020,500	93	16,144,780	7
23	Alabama	225,590,900	192,796,000	85	32,794,900	15
24	New Hampshire and Vermont	214,237,200	200,777,500	93	13,459,700	7
25	West Virginia	177,444,000	143,968,000	81	33,476,000	19
26	Maine	175,318,610	161,156,573	92	14,162,037	8
27	Texas	139,400,000	131,610,100	94	7,789,900	6
28	Delaware	124,368,500	114,368,500	92	10,000,000	8
29	South Carolina	115,420,000	95,876,900	83	19,543,100	17
30	Arkansas	97,368,900	94,349,800	97	3,019,100	3
31	Montana, New Mexico, and Nevada	62,723,400	56,705,400	90	6,018,000	10
32	North Dakota, Utah, and Wyoming	62,053,200	51,498,000	83	10,555,200	17
33	North Carolina	56,702,000	51,672,800	91	5,029,200	9
34	Oregon	51,226,800	50,072,400	97	1,154,400	3
35	Nebraska	50,118,500	44,696,800	89	5,421,700	11
36	California	41,897,000	41,897,000	100		
37	Louisiana and Mississippi	28,500,000	28,500,000	100		
	Total	33,483,430,989	31,049,461,511	92	2,433,969,478	8

PRODUCTION OF COKE.

The total quantity of coke produced at gas works and in retort ovens in 1903 was 3,941,282 short tons, of which 1,882,394 short tons were the output of retort ovens and 2,058,888 short tons were the product of gas houses and generally classed as gas-house coke. In 1902 the total production of coke in gas works and retort ovens amounted to 3,373,294 short tons, of which 1,974,175 short tons were made in gas works as a by-product, and 1,399,119 short tons were the primary product of retort coke ovens.

The total quantity of coal carbonized at the gas houses and by-product coke works of the United States in 1902 was 5,008,761 short tons, of which 1,935,348 short tons, or 38.6 per cent, were coked in by-product coke ovens, and 3,073,413 short tons, or 61.4 per cent, were used in gas works. In 1903 the total quantity of coal carbonized was 5,843,538 short tons, of which 2,605,453 short tons, or 44.6 per cent, were used in by-product ovens, and 3,238,085 short tons, or 55.4 per cent, consumed in gas works.

Many gas companies are engaged also in the electric-light business, and coke produced at the gas works, as well as a considerable amount 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 gas works. It will be noted, therefore, that not all of the coke produced at gas works in the United States is sold, a considerable quantity of it being consumed at the works where it is produced. The total production is given as nearly as possible in these reports, the quantity consumed being arrived at as accurately as possible, and the value placed upon it is the same as that received for the coke sold.

The following tables give the production of coke at gas works and in by-product ovens in 1902 and 1903, by States, arranged according to their rank in producing importance:

Rank of States in production of coke in gas works and by-product ovens in 1902.

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	60,722	66.2	3.68	223,778
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	51,898
26	New Hampshire and Vermont	9,796	54.5	4.95	48,523
27	Maine	9,272	57.4	5.05	46,827
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	3,373,294	67.8	3.336	11,251,164

Rank of States in production of coke in gas works and by-product ovens in 1903.

Rank.	State.	Number of establishments.	Quantity.	Total value.	Value per ton.	Yield of coal in coke.
			Short tons.			*Per cent.*
1	Massachusetts	45	599,320	$2,123,771	$3.54	69.5
2	Pennsylvania	81	573,865	1,712,994	2.98	70.1
3	New York	56	422,342	1,587,314	3.76	66.2
4	Alabama	11	402,867	1,218,166	3.02	69.9
5	Ohio	48	359,108	1,076,437	2.997	65.7
6	Michigan	37	238,172	1,043,388	4.38	67.9
7	Maryland and District of Columbia	9	216,833	694,873	3.20	72.4
8	New Jersey	15	158,623	467,380	3.04	68.1
9	West Virginia	6	152,497	443,998	2.91	73.0
10	Missouri	21	125,338	431,579	3.44	62.9
11	Illinois	45	111,881	469,927	4.20	62.1
12	Wisconsin	16	89,886	341,498	3.80	69.2
13	Indiana	30	56,933	223,720	3.98	59.4
14	Kentucky	11	51,174	156,924	3.07	67.1
15	Tennessee	8	43,065	148,823	3.46	60.6
16	Minnesota	5	42,020	203,424	4.84	65.3
17	Connecticut	9	35,855	165,231	4.608	56.8
18	Virginia	14	33,766	111,467	3.30	60.6
19	Colorado	5	32,336	116,697	3.61	67.2
20	Rhode Island	8	31,757	151,435	4.76	58.3
21	Iowa	16	28,186	154,181	5.47	61.8
22	Georgia	9	25,878	74,973	2.897	55.9
23	Washington	7	19,432	65,035	3.347	61.8
24	Kansas	11	17,524	67,522	3.85	62.6
25	New Hampshire and Vermont	7	12,774	64,790	5.07	57.4
26	Maine	7	10,168	47,661	4.687	56.7
27	Texas	8	8,755	50,112	5.72	55.9
28	South Carolina	3	8,711	46,247	5.31	70.7
29	Delaware	3	8,710	28,443	3.26	63.4
30	Arkansas	5	6,326	22,277	3.52	59.9
31	Montana, New Mexico, and Nevada	5	4,586	25,639	5.59	65.5
32	Oregon	4	3,894	18,896	4.85	62.6
33	North Carolina	6	3,329	16,849	5.06	52.6
34	Nebraska	3	3,307	17,550	5.30	59.3
35	North Dakota, Utah, and Wyoming	3	3,038	17,720	5.83	45.6
36	Louisiana and Mississippi	3	2,208	8,453	3.83	64.6
37	California	3	1,818	18,701	10.29	64.7
	Total	528	3,941,282	13,634,095	3.46	67.4

PRODUCTION OF COAL TAR.

The total quantity of coal tar produced in 1903 was 62,964,393 gallons, valued at $2,199,969, or 3.49 cents per gallon, against 53,099,508 gallons in 1902, valued at $1,871,243, an average of 3.524 cents per gallon. In 1903 the yield of tar per ton of coal was 10.77 gallons, and in 1902 it was 10.6. The price in 1903 ranged from 1.62 cents per gallon in Maryland and the District of Columbia, with an average of 10.46 cents in Montana, New Mexico, and Nevada. In 1902 the lowest price reported was from Alabama, 2.7 cents per gallon, and the highest price reported was from Oregon, at 10 cents per gallon. The largest production of tar in both 1902 and 1903 was in Massachusetts, with New York second, Ohio third, Pennsylvania fourth, and Alabama fifth, in both years.

The following tables give the production of coal tar in 1902 and 1903 by States arranged according to their producing importance:

Rank of States in coal-tar production in 1902.

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	a1,928,033	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	982,046	10.7	3.77	37,040
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
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	569,488	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	15,808
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	53,099,508	10.6	3.524	1,871,243

a Includes some tar made in water-gas manufacture.

Rank of States in coal-tar production in 1903.

Rank.	State.	Number of establishments.	Quantity.	Total value.	Value per gallon.	Yield per ton of coal.
			Gallons.		*Cents.*	*Gallons.*
1	Massachusetts	45	8,798,963	$299,709	3.4	10.2
2	New York	56	7,109,647	216,736	3.05	11.14
3	Ohio	48	6,790,239	249,233	3.66	12.43
4	Pennsylvania	31	6,596,973	228,268	3.46	8.06
5	Alabama	11	4,960,713	123,384	2.49	8.6
6	Maryland and District of Columbia	9	4,633,251	75,028	1.62	15.5
7	Michigan	37	3,601,866	125,506	3.48	10.27
8	Missouri	21	2,606,052	117,967	4.5	13.07
9	Wisconsin	16	*a*2,389,863	89,031	3.7	18.4
10	New Jersey	15	2,151,405	70,260	3.26	9.5
11	West Virginia	6	2,083,631	64,457	3.09	9.98
12	Illinois	45	2,060,620	95,115	4.6	11.43
13	Indiana	30	1,094,445	49,629	4.5	11.4
14	Kentucky	11	892,280	39,495	4.4	11.7
15	Tennessee	8	851,812	35,853	4.2	11.99
16	Rhode Island	3	746,178	46,979	6.3	13.7
17	Minnesota	5	739,538	25,954	3.5	11.49
18	Connecticut	9	626,399	30,653	4.89	10.27
19	Colorado	5	612,184	30,506	4.98	12.7
20	Virginia	14	606,994	25,293	4.16	10.89
21	Iowa	16	516,187	23,317	4.5	11.3
22	Georgia	9	427,631	18,314	4.3	9.2
23	Washington	7	347,342	23,200	6.68	11.04
24	Kansas	11	312,024	13,752	4.4	11.15
25	New Hampshire and Vermont	7	257,196	14,238	5.5	11.56
26	Maine	7	239,287	12,872	5.38	13.35
27	Texas	3	154,629	13,373	8.6	9.9
28	Delaware	3	147,812	5,959	4.03	10.77
29	South Carolina	3	132,821	6,429	4.8	10.8
30	Arkansas	5	117,476	5,562	4.7	11.1
31	North Dakota, Utah, and Wyoming	3	77,000	4,770	6.2	11.57
32	Nebraska	3	62,974	2,680	4.25	11.3
33	North Carolina	6	58,472	3,682	6.3	9.23
34	Oregon	4	55,877	5,040	9.02	8.98
35	Montana, New Mexico, and Nevada	5	42,212	4,416	10.46	6.08
36	Louisiana and Mississippi	3	34,000	1,720	5.06	9.9
37	California	3	28,400	1,589	5.6	10.11
	Total	528	62,964,393	2,199,969	3.49	10.77

a Includes some tar made in water-gas manufacture.

PRODUCTION OF AMMONIA.

Of the total number of companies manufacturing coke and gas, either in retort ovens or at gas works, only about 20 per cent reported the recovery of ammonia either in the form of ammoniacal liquor or sulphate. From these the amount of ammonia liquor produced and sold in 1902 was 51,549,451 gallons, equivalent to 14,906,913 pounds of anhydrous ammonia (NH_3), and equivalent also to 57,839,165 pounds of sulphate. The total quantity of sulphate produced and sold was 11,276,502 pounds. The total quantity of ammonia sold, reduced to equivalent in sulphate, was 69,115,667 pounds. In 1903 the total quantity of ammonia liquor produced and sold was 64,396,662 gallons, which would be equivalent to 17,479,759 pounds of anhydrous ammonia or 67,821,465 pounds of sulphate. The total quantity of sulphate of ammonia produced and sold in 1903 was 11,925,752 pounds. The total production in 1903, reduced to equivalent in sulphate, was 79,747,217 pounds. In 1902 the value for all kinds sold was $1,377,607, and in 1903 $1,669,715.

The returns showed that ammonia liquor is sold in several ways. Some companies reported the production in liquor ounces, selling at a 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.

The following tables show the production and value of ammoniacal liquor at gas and by-product coke works in 1902 and 1903:

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.				Total value of ammonia liquor.
		In ounces.	Equivalent to anhydrous ammonia (NH_3). Ounces per gallon.	Equivalent to anhydrous ammonia (NH_3). Total in pounds.	Equivalent to sulphate of ammonia (ounces per gallon).	
Short tons.	*Gallons.*					
6,002	36,839	3.00	1.04	2,895	4.05	$111
9,038	374,400	4.94	1.72	40,248	6.67	1,329
31,400	600,000	5.00	1.74	65,250	6.75	2,100
46,890	1,792,800	5.21	1.81	202,810	7.02	10,936
39,379	938,484	5.37	1.87	109,685	7.26	4,288
11,595	362,355	5.60	1.95	44,162	7.56	1,631
150,848	6,394,500	5.78	2.01	803,309	7.80	29,415
536,494	17,917,503	6.00	2.09	2,340,472	8.10	119,755
52,910	1,578,890	6.20	2.16	213,150	8.37	6,931
11,937	319,749	7.00	2.435	48,662	9.45	1,599
233,069	8,263,801	7.48	2.60	1,342,868	10.10	48,756
31,313	857,895	7.57	2.63	141,016	10.20	4,289
42,827	186,062	8.00	2.78	32,328	10.80	2,232
13,104	381,257	8.50	2.96	70,692	11.47	4,975
64,093	1,977,248	9.00	3.13	386,637	12.15	16,861
75,957	1,198,525	10.00	3.48	260,679	13.50	17,629
12,006	60,766	10.10	3.51	13,330	13.63	498
78,705	1,982,159	10.80	3.76	465,377	14.58	41,326
7,392	75,430	11.00	3.827	18,042	14.85	1,320
7,240	131,442	12.00	4.17	34,257	16.17	873
104,680	1,218,639	16.00	5.57	421,238	21.60	21,206
15,000	15,254	18.00	6.26	5,968	24.30	610
11,652	134,000	20.00	6.96	58,290	27.00	6,840
2,923	24,615	38.00	13.22	20,338	51.29	585
23,685	98,850	40.00	13.92	85,999	53.99	1,533
4,896	8,000	42.00	14.61	7,305	56.69	650
19,577	36,679	48.00	16.70	38,284	64.79	2,568
13,904	32,080	50.00	17.39	34,867	67.47	2,001
32,949	84,316	52.00	18.09	95,330	70.19	6,970
37,044	100,445	56.00	19.48	122,291	75.58	10,299
3,982	2,458	58.00	20.18	3,100	78.29	172
5,645	2,424	59.16	20.58	3,118	79.86	234
266,927	646,714	60.00	20.87	843,558	80.99	76,358
166,917	540,404	62.00	21.57	728,532	83.69	72,400
26,399	54,736	62.64	21.79	74,544	84.54	3,722
139,056	416,219	64.00	22.26	579,065	86.39	50,150
18,596	24,666	65.60	22.82	35,180	88.55	3,330
200,015	227,315	67.80	23.59	335,147	91.53	35,405
12,666	1,080	68.16	23.71	1,600	91.99	133
183,826	638,353	71.00	24.70	986,544	95.84	94,021
9,363	11,553	72.00	25.05	18,087	97.19	638
24,138	40,195	80.00	27.83	69,914	107.98	4,528
212,356	648,882	90.00	30.92	1,253,950	119.97	128,415
483,146	1,087,726	100.00	34.79	2,393,026	134.99	216,363
9,771	23,743	103.00	35.83	58,169	139.03	2,187
3,436,312	51,549,451	....	....	14,906,813	....	1,057,922

Production and value of ammoniacal liquor at gas and by-product coke works of United States in 1903.

Coal carbonized.	Quantity of ammonia liquor made and sold.	Strength of liquor.				Total value of ammonia liquor.
		In ounces.	Equivalent to anhydrous ammonia (NH_3).		Equivalent to sulphate of ammonia (ounces per gallon).	
			Ounces per gallon.	Total in pounds.		
Short tons.	*Gallons.*					
14,659	1,138,533	3.00	1.04	74,005	4.05	851
13,209	412,790	3.75	1.30	33,539	5.06	1,238
144,764	12,347,210	4.00	1.39	790,474	5.40	73,846
3,542	48,245	4.5	1.57	4,734	6.07	284
38,535	817,361	5.00	1.74	88,888	6.75	8,474
20,255	799,123	5.126	1.78	88,902	6.92	8,154
167,329	7,218,822	5.5	1.91	861,747	7.42	31,763
55,000	1,836,000	5.81	2.02	231,795	7.84	12,390
242,950	8,121,848	6.00	2.09	1,060,917	8.10	43,454
55,458	1,810,944	6.3	2.19	247,872	8.50	6,902
134,928	4,802,000	6.7	2.33	699,291	9.04	38,896
289,742	11,165,177	6.97	2.42	1,688,733	9.41	65,875
80,484	2,441,560	8.00	2.78	425,106	10.80	14,993
36,856	967,705	8.14	2.83	171,163	10.99	5,067
35,569	1,244,898	9.00	3.13	243,533	12.15	10,671
48,267	601,309	10.00	3.48	130,786	13.50	6,472
13,924	67,560	11.00	3.827	16,160	14.85	836
8,759	21,700	13.00	4.52	6,130	17.55	490
3,400	26,773	14.43	5.02	8,400	19.48	588
40,477	541,115	15.5	5.39	182,288	20.92	15,494
137,403	1,410,719	16.00	5.57	491,106	21.60	23,080
19,318	88,000	18.00	6.26	34,415	24.30	1,885
3,360	4,000	29.5	10.26	2,565	39.82	180
9,769	14,768	30.00	10.44	9,636	40.50	266
74,601	396,934	32.00	11.13	276,117	43.19	23,480
2,934	5,222	35.04	12.19	3,979	47.30	251
3,446	9,689	35.52	12.36	7,485	47.95	524
15,226	355,905	36.00	12.52	278,496	48.60	6,962
6,607	5,920	36.54	12.71	4,703	49.32	188
3,006	27,301	38.00	13.22	22,557	51.29	648
10,197	17,865	40.00	13.92	15,543	53.99	992
9,000	56,122	41.44	14.42	50,580	55.93	3,794
5,600	11,000	42.00	14.61	10,044	56.69	894
15,446	8,066	43.00	14.96	7,542	58.04	251
31,253	46,260	44.96	15.64	45,219	60.69	2,826
9,957	20,223	45.00	15.66	19,793	60.74	1,314
12,364	15,362	48.00	16.70	16,034	64.79	962
50,108	133,098	49.36	17.17	142,831	66.63	12,658
3,899	8,140	50.00	17.39	8,847	67.47	228
22,455	68,934	52.00	18.09	77,938	70.19	5,789
32,165	71,000	54.00	18.79	83,381	72.89	3,938
5,600	20,000	55.00	19.13	23,913	74.24	770
64,310	127,988	56.00	19.48	155,827	75.58	12,112
6,083	8,777	59.2	20.60	11,301	79.91	791
249,648	766,823	60.00	20.87	1,000,227	80.99	82,006
30,000	60,126	60.64	21.10	79,291	81.86	5,154

Production and value of ammoniacal liquor at gas and by-product coke works of United States in 1903—Continued.

Coal carbonized.	Quantity of ammonia liquor made and sold.	Strength of liquor. In ounces.	Equivalent to anhydrous ammonia (NH_3). Ounces per gallon.	Equivalent to anhydrous ammonia (NH_3). Total in pounds.	Equivalent to sulphate of ammonia (ounces per gallon).	Total value of ammonia liquor.
Short tons.	*Gallons.*					
263,351	105,401	64.00	22.26	146,639	86.39	61,173
151,489	376,190	65.00	22.61	531,600	87.74	47,848
134,996	515,160	66.00	22.96	680,012	89.09	70,635
114,795	289,279	67.48	23.48	424,517	91.09	87,230
11,741	63,688	68.00	23.66	94,178	91.79	9,418
13,093	10,363	68.16	23.71	15,357	91.99	1,280
249,326	291,555	69.52	24.19	440,795	93.84	45,727
46,356	21,356	72.00	25.05	32,130	97.19	1,666
1,864	2,220	76.00	26.44	3,669	102.59	255
22,009	30,000	80.00	27.83	52,181	107.98	4,051
87,531	286,965	82.00	28.53	473,377	110.66	41,527
33,842	108,270	86.00	29.92	186,225	116.09	14,965
548,146	1,485,345	104.00	36.18	3,087,522	140.38	257,586
186,691	471,210	112.00	38.96	1,055,509	151.18	117,759
73,224	150,745	114.00	39.66	322,215	153.88	37,942
4,220,319	64,396,662	....	....	17,479,759	....	1,277,743

In the following tables are shown the quantity of coal carbonized, the quantity of ammonia liquor produced, and its equivalent in anhydrous ammonia, by States, and the total quantity of ammonia produced and sold as sulphate, in 1902 and 1903:

Production of ammonia in 1902 and 1903, by States.

State.	1902.			1903.		
	Coal carbonized.	Ammonia liquor produced.	Equivalent to anhydrous ammonia (NH_3).	Coal carbonized.	Ammonia liquor produced.	Equivalent to anhydrous ammonia (NH_3).
	Short tons.	*Gallons.*	*Pounds.*	*Short tons.*	*Gallons.*	*Pounds.*
Alabama and Georgia	452,211	1,128,542	2,436,554	591,239	1,555,834	3,182,170
Colorado, Oregon, and Washington	[a] 64,200	[a] 1,195,924	[a] 209,111	61,801	1,008,911	211,465
Connecticut and Rhode Island	57,627	1,169,227	161,711	69,282	2,190,692	367,934
Delaware and New Jersey	111,243	1,285,676	265,094	210,593	1,383,393	688,906
Illinois	71,533	179,541	194,252	98,899	231,565	239,720
Indiana	49,000	192,266	55,150	47,478	50,245	61,534
Kentucky and Tennessee	112,550	2,600,691	440,006	131,695	2,726,717	482,652
Maine and New Hampshire	22,143	259,802	75,193	23,499	163,989	61,584
Maryland and District of Columbia	48,405	983,323	123,210	296,027	1,169,967	220,031
Massachusetts	758,917	2,181,495	600,413	744,944	2,433,688	857,922
Michigan	126,796	2,063,926	656,758	287,229	12,796,980	1,286,953
Minnesota and Wisconsin	[b] 134,853	[b] 313,020	[b] 412,038	135,564	407,017	513,002
Missouri	162,174	5,553,649	721,942	173,384	6,787,901	866,932
New York	513,996	11,859,944	2,484,645	569,370	14,514,289	2,755,695
Ohio	427,565	12,407,594	1,985,382	434,572	13,265,377	2,000,492
Pennsylvania	710,570	7,122,014	2,773,632	797,166	2,957,961	2,574,295
Virginia and West Virginia	258,095	1,052,817	1,311,715	219,481	757,136	1,108,472
Total	4,077,478	51,549,451	14,906,806	4,887,163	64,396,662	17,479,759
Amount of ammonia produced and sold as sulphate, (pounds)		11,276,502			12,453,554	

[a] Also includes production of California in 1902.
[b] Also includes production of Iowa in 1902.

Production of ammonia at gas and by-product coke works of the United States in 1902 and 1903.

	1902.	1903.
Coal carbonized at works which produced and sold ammonia liquor..net tons..	3,436,312	4,220,319
Coal carbonized at works which produced sulphate of ammonia.......do....	641,166	666,844
Total coal carbonized.......do....	4,077,478	4,887,163
Ammonia liquor produced and sold.......gallons..	51,549,451	64,396,662
Equivalent to anhydrous ammonia (NH_3).......pounds..	14,906,813	17,479,759
Equivalent to sulphate of ammonia.......do....	57,839,165	67,821,465
Sulphate of ammonia produced and sold.......do....	11,276,502	11,925,752
Value received for ammonia liquor	$1,057,922	$1,277,743
Value received for sulphate of ammonia	319,685	391,972
Total value received	1,377,607	1,669,715

AGGREGATE PRODUCTION AND VALUE.

In the following tables are shown in condensed form the quantity and value of the coke, gas, tar, and ammonia produced at gas works and retort ovens of the United States in 1902 and 1903, by States. The aggregate value of these products in 1902 was $43,842,895, and in 1903 $47,819,555.

Production of gas and by-products in the 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.*	*Short 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	1,285,676	84,494	34,213,602
Illinois	1,326,793,560	1,852,781	179,541	94,834	70,769,910
Indiana	761,832,320	982,046	192,266	60,722	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	87,288,730
Louisiana and Mississippi	50,025,490	66,500	....	4,125	....
Maine, New Hampshire, and Vermont	345,214,450	427,625	259,802	19,068	26,582,780
Maryland and District of Columbia	447,274,990	569,483	983,323	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	602,743	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	1,052,817	210,841	38,749,737
Total	29,079,073,555	53,099,508	51,549,451	3,373,294	1,685,551,777

Production of gas and by-products in the United States in 1903, 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.*	*Short tons.*	*Cubic feet.*
Alabama and Georgia	581,536,650	5,388,344	1,555,834	428,745	33,910,850
Arkansas	94,349,800	117,476	....	6,326	3,019,100
California	41,897,000	28,400	....	1,818	....
Colorado, Oregon, and Washington	789,616,200	1,015,403	1,003,911	55,662	60,775,827
Connecticut and Rhode Island	1,079,809,110	1,372,577	2,190,692	67,612	67,503,490
Delaware and New Jersey	1,190,755,869	2,299,217	1,383,393	162,333	49,452,336
Illinois	1,488,745,325	2,060,620	231,565	111,881	136,916,143
Indiana	783,838,930	1,094,445	50,245	56,933	55,046,340
Iowa	369,148,140	516,187	....	28,186	46,612,960
Kansas	225,020,500	312,024	....	17,524	16,144,780
Kentucky and Tennessee	1,125,346,886	1,744,092	2,726,717	94,239	164,224,446
Louisiana and Mississippi	28,500,000	34,000	....	2,208	....
Maine, New Hampshire, and Vermont	361,934,073	496,483	163,989	22,942	27,621,737
Maryland and District of Columbia	483,912,539	4,633,251	1,169,967	216,883	7,253,821
Massachusetts	4,625,694,735	8,798,963	2,433,688	599,320	222,241,645
Michigan	2,050,748,600	3,601,866	12,796,980	238,172	74,281,900
Minnesota and Wisconsin	1,716,481,400	3,129,401	407,017	131,906	160,189,385
Missouri	1,554,113,184	2,606,052	6,787,901	125,338	254,623,536
Montana, New Mexico, and Nevada	56,705,400	42,212	....	4,586	6,018,000
Nebraska	44,696,800	62,974	....	3,307	5,421,700
New York	5,152,439,059	7,109,647	14,514,289	422,342	363,907,953
North Carolina	51,672,800	58,472	....	3,329	5,029,200
South Carolina	95,876,900	132,821	....	8,711	19,543,100
North Dakota, Utah, and Wyoming	51,498,000	77,000	....	3,038	10,555,200
Ohio	4,204,558,946	6,790,239	13,265,377	359,108	395,378,514
Pennsylvania	2,185,690,479	6,596,973	2,957,961	573,865	146,401,221
Texas	131,610,100	154,629	....	8,755	7,789,900
Virginia and West Virginia	483,264,086	2,690,625	757,136	186,263	94,106,394
Total	31,049,461,511	62,964,393	64,396,662	3,941,282	2,433,969,478

Value of gas and by-products produced in the United States in 1902, by States.

State.	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	44,708	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	37,040	11,772	223,778	272,590	1,056,024
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	16,306	107,584
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	140,005	1,234,840	1,579,157	6,914,288
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	1,871,243	1,377,607	11,251,164	14,500,014	43,842,895

Value of gas and by-products produced in the United State in 1903, by States.

State.	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	$682,442	$141,698	$264,020	$1,293,139	$1,698,857	$2,381,299
Arkansas	158,440	5,562	....	22,277	27,839	186,279
California	85,405	1,589	....	18,701	20,290	105,695
Colorado, Oregon, and Washington	1,059,627	58,746	6,316	200,628	265,690	1,325,317
Connecticut and Rhode Island	1,273,965	77,632	12,541	316,666	406,839	1,680,804
Delaware and New Jersey	1,288,363	76,219	58,659	495,823	630,701	1,919,064
Illinois	1,692,141	95,115	20,159	469,927	585,201	2,277,342
Indiana	794,439	49,629	13,716	223,720	287,065	1,081,504
Iowa	479,164	23,317	....	154,181	177,498	656,662
Kansas	308,601	13,752	....	67,522	81,274	389,875
Kentucky and Tennessee	1,125,610	75,348	26,028	305,747	407,123	1,532,733
Louisiana and Mississippi	42,531	1,720	....	8,453	10,173	52,704
Maine, New Hampshire, and Vermont	507,317	27,110	2,504	112,451	142,065	649,382
Maryland and District of Columbia	521,063	75,028	109,895	694,873	879,796	1,400,859
Massachusetts	3,332,877	299,709	341,318	2,123,771	2,764,798	6,097,675
Michigan	1,715,220	125,506	121,371	1,043,388	1,290,265	3,005,485
Minnesota and Wisconsin	1,848,463	114,985	31,380	544,922	691,287	2,539,750
Missouri	1,493,039	117,967	43,185	431,579	592,731	2,085,770
Montana, New Mexico, and Nevada	98,758	4,416	....	25,639	30,055	128,813
Nebraska	65,660	2,680	....	17,550	20,230	85,890
New York	5,351,987	216,736	146,927	1,587,314	1,950,977	7,302,964
North Carolina	84,434	3,682	....	16,849	20,531	104,965
South Carolina	133,320	6,429	....	46,247	52,676	185,996
North Dakota, Utah, and Wyoming	82,041	4,770	....	17,720	22,490	104,531
Ohio	3,201,269	249,233	96,662	1,076,437	1,422,332	4,623,601
Pennsylvania	2,177,943	228,268	254,894	1,712,994	2,196,156	4,374,099
Texas	205,949	13,373	....	50,112	63,485	269,434
Virginia and West Virginia	505,708	89,750	120,140	555,465	765,355	1,271,063
Total	30,315,776	2,199,969	1,669,715	13,634,095	17,503,779	47,819,555

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. The value of the coal tar produced in the calendar year 1903 was $2,199,969. 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 1896–1904.

Fiscal year.	Salicylic acid.		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	201,960	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.	789,568	Free.	5,252,611	1,575,783
1904	7,305	3,276	636,418	Free.	686,184	Free.	4,903,077	1,470,923

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
1904	522,242	104,448	391,645	Free.	7,146,871	1,578,647

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 1903:

(1) The production was greater than that of any previous year.

(2) The great increase was due to the remarkable output in California, now larger than that of any other State, and to a less extent to the increased production in Indiana, Kansas, Kentucky, and Louisiana, and to the large production maintained by Texas.

(3) The remarkably regular output of the Appalachian and the Lima-Indiana fields combined has continued for many years, but the large production of late in the newer fields of the South and West has caused a rapid shifting of the proportions or percentages of the whole output from the older to the newer fields, where a large quantity of the inferior grades of petroleum is consumed as fuel, especially in California, Texas, and Louisiana.

(4) The general average price paid for crude petroleum was greater by 14.07 cents per barrel than the average price for 1902. The average price paid for Pennsylvania petroleum showed an increase of 35.25 cents; and the average price in the Lima-Indiana field was about 27 cents per barrel more in 1903 than in 1902.

(5) Stocks held in tanks in both the Appalachian and the Lima-Indiana fields were considerably decreased during the year.

(6) There was a slight decline in the quantity of all grades of petroleum exported during 1903, and a slight gain in the value of the same when compared with that of 1902. There was a decided decrease in the quantity of the illuminating petroleum exported, and a considerable increase in both quantity and value of the lubricating petroleum exported during 1903 over the previous year.

[a] Credit should be given for much of the statistical information as to the United Staets in this report to the Oil City Derrick, and to Miss Belle Hill, special agent U. S. Geological Survey, Pittsburg, Pa., for the careful compilation of most of the tables. Other special acknowledgments are made in the body of the report.

(7) The demand for home consumption continued to increase during 1903, the western demand being partly supplied by refineries in Texas, Kansas, and Colorado.

INCREASE IN THE PRODUCTION OF THE UNITED STATES.

The total production of crude petroleum in the United States in 1903 was 100,461,337 barrels, being larger than that of any previous year and greater than that of 1902 by 11,694,421 barrels, a gain of 13.17 per cent as compared with a gain of 27.92 per cent in 1902 over 1901. The greatest part of the increase during 1903 was from the State of California, which in 1903 produced 24.27 per cent, or nearly one-fourth, of the entire production. This State in 1902 produced 15.75 per cent of the whole production, 12.66 per cent in 1901, and only 6.79 per cent in 1900. The increase in California in 1903 was 10,398,204 barrels, or 74.36 per cent of the production of 1902.

Next to California the largest gain in production was in Indiana, which was 1,705,515 barrels, or 22.80 per cent of the production of 1902. Kansas showed a remarkable gain in production of 600,465 barrels, or 181 per cent; Kentucky and Louisiana showed gains of about 369,000 barrels each; Indian Territory gained 101,811 barrels, or 274.4 per cent; and New York gained 43,248 barrels, or 3.86 per cent in 1903 as compared with 1902.

On the other hand there was a slight decrease of 128,086 barrels, or 0.708 per cent in Texas; and Ohio, Pennsylvania, and West Virginia, all showed decreased production, amounting to a total of 1,856,619 barrels, or 3.98 per cent in 1903 as compared with 1902. The largest decrease in production in 1903 was in Pennsylvania, and amounted to 708,724 barrels.

PERCENTAGE OF PRODUCTION BY FIELDS.

The following table reveals the fact that in the last six years there has been a very remarkable change in the percentage of the local production. The Appalachian and the Lima-Indiana fields, which for many years produced all but a very small percentage of the whole, in the year 1903 produced only 55.38 per cent of the total as compared with 93.99 per cent in 1898. The Appalachian and the Lima-Indiana fields have continued regularly for the last ten years to produce about 55,000,000 barrels per year. California has increased its production since 1900 in the most remarkable manner, so that during 1903 it produced 127,921 more barrels of petroleum than did the States of Pennsylvania and West Virginia combined. Texas has also been a very important factor in bringing about the readjustment of the percentages of production. The production in Texas in 1903 was only slightly less than in 1902, but the great increase in California caused Texas to show a much less percentage of the total in 1903 than in 1902; in 1902, in fact, the Texas percentage of the total production was greater than that of California. All the other States, combined under the head of all other fields, show an increase in 1903 of nearly 1 per cent over 1902, which in round numbers represents 1,000,000 barrels.

Percentages of total crude petroleum produced in the several fields, 1898–1903.

Field.	1898.	1899.	1900.	1901.	1902.	1903.
Appalachian	57.29	57.94	57.05	48.45	36.07	31.41
California	4.08	4.63	6.79	12.66	15.75	24.27
Lima-Indiana	36.70	35.44	34.20	31.61	26.31	23.97
Texas	.98	1.17	1.31	6.33	20.37	17.87
All other	.95	.82	.65	.95	1.50	2.48
Total	100.00	100.00	100.00	100.00	100.00	100.00

The increased production in the States of Texas, Louisiana, and California of large quantities of an inferior grade of petroleum during the years 1902 and 1903 required for its consumption new markets and new conditions of transportation that were unknown to the older fields, and also demanded that a large amount of capital 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; most of the problems connected with its production and transportation have been solved, and during 1903 its consumption for fuel purposes and as an enricher of manufactured gas has been very largely increased.

A very considerable quantity of Texas petroleum has been refined with satisfactory results, although the percentage of the yield is much smaller than from the eastern petroleum. When the value of the petroleum produced in the Appalachian and the Lima-Indiana fields is considered in comparison with that of all the remaining fields, it is found that 82 per cent of the total value comes from the 55.38 per cent of the total production furnished by those fields, the remaining 44.62 per cent of the production receiving 18 per cent of the total value, so that 3.8 barrels of the southern and western petroleum is required to equal the value of 1 barrel of that produced in the Appalachian and the Lima-Indiana fields.

INCREASE IN PRICE AND TOTAL VALUE.

When the total value of the production in 1903, which was $94,694,050, is compared with $71,178,910, the value in 1902, the former shows a gain of $23,515,140, or 33 per cent. The production of Ohio was valued at $26,234,521 in 1903; West Virginia at $20,516,532; Pennsylvania at $18,170,881; Indiana at $10,474,127; Texas at $7,517,479; and California, which produced the largest number of barrels of crude petroleum, was valued at only $7,399,349.

The average price of all the petroleum produced and marketed during 1903 was 94.26 cents per barrel, as compared with 80.19 cents per barrel in 1902, an increase of 14.07 cents per barrel as compared with a decrease of 15.51 cents per barrel when the value received for the production of 1902 is compared with that of 1901. For the last two years the increasing quantity of cheaper petroleum produced has had its influence in reducing the average price per barrel of the entire production, notwithstanding that much higher prices was paid for eastern petroleum in 1903 than in 1902.

The average price paid for Pennsylvania petroleum, which is about 95 per cent of the entire production of the Appalachian field in 1903, was $1.59 per barrel, as compared with $1.23¾, the average price paid in 1902. This shows the remarkable gain of 35¼ cents per barrel in the price paid during 1903 over that of 1902. There was also a gain of about 27 cents per barrel in the price paid for the production in the Lima-Indiana field during 1903 over that of 1902. On the other hand, the average price of California petroleum decreased from 34.8 cents per barrel for the year 1902 to 30.3 cents for 1903, a decrease of 4.5 cents per barrel, the lowest price at which any petroleum was marketed during 1903. The price of the Texas petroleum showed a large advance in the average price paid, as the production of 1903 averaged 41.87 cents per barrel as compared with 22.1 cents for that of 1902, a gain of 19.77 cents, or 89 per cent. The highest price quoted during the year was $7 per barrel for the lubricating petroleum produced in Wyoming.

INCREASE IN THE NUMBER OF WELLS DRILLED.

The total number of wells drilled in the United States during the year 1903 was 18,880; of this number 4,650 were dry, leaving 14,230 as the number of productive wells, as compared with 11,326 productive wells in 1902. At an average cost of $1,400 per well, this total number represents an investment in 1903 of $26,402,000.

The total number of wells drilled in the Appalachian and the Lima-Indiana fields during 1903 was 16,232. Of this number 2,889 were dry, leaving 13,343 productive wells. The proportion of productive wells to dry holes in these fields in 1903 was as 78½ to 21½, as compared with 80 to 20 in 1902, and with 78 to 22 in 1901.

DECREASE IN EXPORTS.

The exports of petroleum and its products during 1903 was slightly less than 1,000,000,000 gallons. The quantity was 936,699,145 gallons, valued at $72,628,539, a decrease as compared with 1902 of 127,534,456 gallons in quantity, but an increase in value of $4,031,396, chiefly the result of an increased quantity of lubricating petroleum exported in

1903 over any previous year. There was a decline in the quantity of illuminating petroleum exported, accompanied by a slight increase in the value.

NEW POOLS DISCOVERED.

The only important pool discovered during 1903 was that known as the Batson Prairie, west of Saratoga, Hardin County, Tex. There were numerous extensions of territory in Kansas and Indian Territory, and a vast amount of territory well inside of limits defined during 1902 was opened and tested. This field began this year to assume a much more important position as productive and profitable territory. The developments in Alaska have not yet sustained the predictions made last year.

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 1902 and 1903, by States and important districts:

Total quantity and value of crude petroleum produced in the United States and the average price per barrel in 1902 and 1903.

State and district.	1902.			1903.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
	Barrels.			*Barrels.*		
California	13,984,268	$4,873,617	$0.348	24,382,472	$7,399,349	$0.303
Colorado	396,901	484,683	1.22	483,925	431,723	.892
Illinois	200	1,000	5.00	....	....	....
Indiana	7,480,896	6,526,622	.872	9,186,411	10,474,127	1.14
Indian Territory Oklahoma Territory	37,100	32,940	.888	138,911	142,402	1.025
Kansas	331,749	292,464	.88	932,214	988,220	1.06
Kentucky Tennessee	185,331	141,044	.76	554,286	486,083	.877
Louisiana	548,617	188,985	.344	917,771	416,228	.4535
Michigan Missouri	757	1,066	1.41	3,000	4,650	1.55
New York	1,119,730	1,530,852	1.367	1,162,978	1,849,135	1.59
Ohio:						
Eastern and southern	5,136,366	6,471,821	1.26	5,585,858	8,881,514	1.59
Lima	15,877,730	14,284,072	.899	14,893,853	17,351,339	1.165
Mecca Belden	135	1,466	10.86	575	1,668	2.90
Total	21,014,231	20,757,359	.988	20,480,286	26,234,521	1.28
Pennsylvania:						
Franklin	50,555	199,432	3.945	48,209	192,836	4.00
Pennsylvania	12,012,125	15,064,861	1.254	11,305,692	17,976,050	1.59
Smiths Ferry	1,200	1,800	1.50	1,255	1,995	1.59
Total	12,063,880	15,266,093	1.265	11,355,156	18,170,881	1.60

Total quantity and value of crude petroleum produced in the United States and the average price per barrel in 1902 and 1903—Continued.

State and district.	1902.			1903.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
	Barrels.			*Barrels.*		
Texas	18,083,658	3,998,097	.221	17,955,572	7,517,479	.4187
West Virginia:						
West Virginia	13,498,685	17,006,469	1.26	12,893,079	20,499,996	1.59
Petroleum / Volcano	a 14,660	33,848	2.31	6,316	16,586	2.62
Total	13,513,345	17,040,317	1.261	12,899,395	20,516,582	1.59
Wyoming	6,258	43,771	7.00	8,960	62,720	7.00
Grand total	b88,766,916	71,178,910	.8019	100,461,337	94,694,050	.9426

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 1903 compared with 1902, are shown in the following table:

Total production of crude petroleum and percentage of increase or decrease, by States, in 1903, as compared with 1902.

State.	Production.		Increase.	Decrease.	Percentage.	
	1902.	1903.			Increase.	Decrease.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*		
California	13,984,268	24,382,472	10,398,204		74.36	
Colorado	396,901	483,925	87,024		21.93	
Illinois	200			200		100.00
Indiana	7,480,896	9,186,411	1,705,515		22.80	
Indian Territory / Oklahoma Territory	37,100	138,911	101,811		274.42	
Kansas	331,749	932,214	600,465		180.99	
Kentucky / Tennessee	185,331	554,286	368,955		199.08	
Louisiana	548,617	917,771	369,154		67.29	
Michigan / Missouri	757	3,000	2,243		296.30	
New York	1,119,730	1,162,978	43,248		3.86	
Ohio	21,014,231	20,480,286		533,945		2.541
Pennsylvania	12,063,880	11,355,156		708,724		5.875
Texas	18,083,658	17,955,572		128,086		.708
West Virginia	13,513,345	12,899,395		613,950		4.543
Wyoming	6,258	8,960	2,707		40.29	
Total	88,766,916	100,461,337	11,694,421		13.17	

RANK OF STATES.

The following tables show the order of production of the several States of the United States, the quantity and value produced by each, and their percentages of the whole in 1902 and 1903:

Rank of petroleum-producing States and Territories, with quantity produced and percentage of each in 1902 and 1903.

1902.				1903.			
State.	Rank.	Quantity.	Percentage.	State.	Rank.	Quantity.	Percentage.
		Barrels.				*Barrels.*	
Ohio	1	21,014,231	23.67	California	1	24,382,472	24.27
Texas	2	18,083,658	20.37	Ohio	2	20,480,286	20.39
California	3	13,984,268	15.75	Texas	3	17,955,572	17.87
West Virginia	4	13,513,345	15.23	West Virginia	4	12,899,395	12.84
Pennsylvania	5	12,063,880	13.59	Pennsylvania	5	11,355,156	11.30
Indiana	6	7,480,896	8.42	Indiana	6	9,186,411	9.14
New York	7	1,119,730	1.26	New York	7	1,162,978	1.16
Louisiana	8	548,617	.62	Kansas	8	932,214	.93
Colorado	9	396,901	.45	Louisiana	9	917,771	.92
Kansas	10	331,749	.38	Kentucky, Tennessee	10	554,286	.55
Kentucky, Tennessee	11	185,331	.21	Colorado	11	483,925	.48
Indian Territory, Oklahoma Territory	12	37,100	.05	Indian Territory, Oklahoma Territory	12	138,911	.15
Wyoming	13	6,253		Wyoming	13	8,960	
Michigan, Missouri	14	757		Michigan, Missouri	14	3,000	
Illinois	15	200		Illinois	15	....	
Total	....	88,766,916	100.00	Total	....	100,461,337	100.00

The increased production in California during 1903, nearly one-fourth of the entire output of the country, has caused it to appear at the head of the list of producing States in the United States, passing Ohio and Texas from third place to first. Ohio has for many years held this distinction. Kansas has also changed places with Louisiana by a small margin.

When the States are arranged according to the value of the petroleum produced in the United States, and not, as in the first of the preceding tables, according to quantity, there is a considerable readjustment for the year 1903. As in the arrangement for 1902 Ohio is first in the list and leads West Virginia by a large percentage. Next in line after West Virginia is Pennsylvania, third, followed by Indiana. Texas is fifth. California is sixth in the list of values, credited with only 7.81 per cent of the total value, though it produced 24.27 per cent of the quantity. Louisiana is eleventh in the list of values and ninth in the list according to quantity.

Rank of petroleum-producing States and Territories, with value of production and percentage of each, in 1902 and 1903.

1902.				1903.			
State.	Rank.	Value.	Percentage.	State.	Rank.	Value.	Percentage.
Ohio	1	$20,757,359	29.16	Ohio	1	$26,234,521	27.70
West Virginia	2	17,040,317	23.94	West Virginia	2	20,516,582	21.66
Pennsylvania	3	15,266,093	21.45	Pennsylvania	3	18,170,881	19.18
Indiana	4	6,526,622	9.17	Indiana	4	10,474,127	11.06
California	5	4,873,617	6.85	Texas	5	7,517,479	7.93
Texas	6	3,998,097	5.62	California	6	7,399,349	7.81
New York	7	1,530,852	2.15	New York	7	1,849,135	1.95
Colorado	8	484,683	.68	Kansas	8	988,220	1.04
Kansas	9	292,464	.41	Kentucky Tennessee	9	486,083	.51
Louisiana	10	188,985	.26	Colorado	10	431,723	.45
Kentucky Tennessee	11	141,044	.20	Louisiana	11	416,228	.44
Wyoming	12	43,771	....	Indian Territory Oklahoma	12	142,402	.15
Indian Territory Oklahoma	13	32,940	.11	Wyoming	13	62,720	....
Michigan Missouri	14	1,066	....	Michigan Missouri	14	4,650	.07
Illinois	15	1,000	....	Illinois	....	....	....
Total	....	71,178,910	100.00	Total	....	94,694,050	100.00

PRODUCTION BY FIELDS AND STATES.

The production of petroleum in the principal fields of the United States from 1898 to 1903, inclusive, was as follows:

Production of petroleum in the United States, 1898–1903, by fields and States.

[Barrels of 42 gallons.]

Field.	1898.	1899.	1900.	1901.	1902.	1903.
Appalachian	31,717,425	33,068,356	36,295,433	33,618,171	32,018,787	31,558,248
Lima-Indiana	20,321,323	20,225,356	21,758,750	21,933,379	23,358,626	24,080,264
California	2,257,207	2,642,095	4,324,484	8,786,330	13,984,268	24,382,472
Colorado	444,383	390,278	317,385	460,520	396,901	483,925
Kansas	71,980	69,700	74,714	179,151	331,749	932,214
Texas	546,070	669,013	836,039	4,393,658	18,083,658	17,955,572
Louisiana	....	....	....	....	548,617	917,771
Indian and Oklahoma Territories	....	....	....	....	37,100	138,911
Wyoming	5,475	5,560	5,450	5,400	6,253	8,960
Other	370	492	8,274	12,585	957	3,000
Total	[a]55,364,233	[a]57,070,850	[b]63,620,529	69,389,194	88,766,916	100,461,337

[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.

This table, showing the production by fields and States in the United States from 1898 to 1903, clearly illustrates the remarkable persistency with which the older fields continue to produce. The regularity of the combined production of the Appalachian and the Lima-Indiana fields is quite marked. Taking the nearest million barrels, the following is the result: 1898, 52 millions; 1899, 53 millions; 1900, 58 millions; 1901, 55.5 millions; 1902, 55.4 millions, and .1903, 55.6 millions. Nearly all the other fields and States show a surprisingly continuous growth since 1896.

COMBINED VALUES OF PETROLEUM AND NATURAL GAS IN 1903.

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 1903, as is shown in the following table:

Value of petroleum and of natural gas produced in 1903, their combined value and percentage, and rank of combined value by States.

State.	Value of crude petroleum.	Value of natural gas.	Value of petroleum and natural gas.	Percentage.	Rank.
Pennsylvania	$18,170,881	$16,182,834	$34,353,715	26.32	1
Ohio	26,234,521	4,479,040	30,713,561	23.53	2
West Virginia	20,516,532	6,882,359	27,398,891	20.99	3
Indiana	10,474,127	6,098,364	16,572,491	12.70	4
Texas	7,517,179	21,351	7,538,830	5.79	5
California	7,399,349	104,521	7,503,870	5.77	6
New York	1,849,135	493,686	2,342,821	1.79	7
Kansas	988,220	1,123,849	2,112,069	1.62	8
Kentucky Tennessee	486,083	390,601	876,684	.65	9
Colorado	431,723	14,140	445,863	.34	10
Louisiana	116,228	....	116,228	.32	11
Indian Territory Oklahoma Territory	142,102	1,000	143,102	.11	12
Arkansas Wyoming	62,720	2,460	65,180		13
Missouri Michigan	4,650	7,070	11,720	.07	14
South Dakota	....	10,775	10,775		15
Illinois	....	3,310	3,310		16
Total	91,691,050	35,815,360	130,509,410	100.00	-

PRODUCTION OF CRUDE PETROLEUM IN UNITED STATES FROM 1859 TO 1903, INCLUSIVE.

In the table following 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 1903, the table being by years and States.

Production of crude petroleum in the United States, 1859–1903, 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
1903	12,518,134	20,480,286	12,899,395	24,382,472	554,286	483,925	9,186,411
Total	640,919,590	304,231,603	144,600,691	66,216,945	1,187,498	7,336,851	55,022,626

[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, 1859–1903, by years and by States—Con.

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	d 757	f 37,100	6,253	548,617	88,766,916
1903		932,214	17,955,572	d 3,000	f 138,911	8,960	917,771	100,461,337
Total	6,576	1,959,707	42,551,796	8,299	193,565	49,450	1,466,388	1,265,751,585

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, 4,825 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.

f Includes production of Oklahoma Territory.

The entire production of petroleum in the United States since it was first discovered in 1859 amounts to 1,265,751,585 barrels. If we allow 5.6 cubic feet for the cubical contents of each barrel, the number of cubic feet would be 7,088,208,876, which would require a cube whose sides would be 1,921 feet in each direction; or the oil would fill a tank whose base is 1 square mile to a height of 254 feet. If we allow 3½ barrels to be the equivalent of 1 ton of average coal, this number of barrels represents 361,643,310 tons of coal. The total quantity of all the coal produced in the United States during 1902 was 301,590,439 short tons.

Of the grand total of all the crude petroleum produced since the beginning in 1903 Pennsylvania produced 50.6 per cent, Ohio 24 per cent, West Virginia 11.4 per cent, California 5.23 per cent, Indiana 4.34 per cent, and Texas 3.36 per cent, leaving only 1 per cent to be supplied by the remainder of the States producing petroleum.

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 quantity of petroleum.

The year 1903 showed in all the States which go to make up the Appalachian field a decrease in production of 460,879 barrels, or about 1.44 per cent, the comparatively small increase in the production in New York, southeastern Ohio, and Kentucky and Tennessee not being sufficient to offset the larger decrease in Pennsylvania and West Virginia.

The following table gives the production of the Appalachian States in 1902 and 1903, 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 1902 and 1903, by States, showing increase or decrease.

State.	Production.		Increase.	Decrease.	Percentage.	
	1902.	1903.			Increase.	Decrease.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*		
New York	1,119,730	1,162,978	43,248	....	3.86	....
Pennsylvania	12,063,880	11,355,156	....	708,724	....	5.875
West Virginia	13,513,345	12,899,395	....	613,950	....	4.543
Southeastern Ohio	5,136,501	5,586,433	449,932	....	8.76	....
Kentucky and Tennessee	185,331	554,286	368,955	....	199.08	....
Total	32,018,787	31,558,248	....	460,539	....	1.439

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 and 1903 in the production in that portion of the Lima-Indiana field lying in Ohio, which was more than offset by the increased production in Indiana The increase in the Indiana portion during 1903 was 1,705,515, and the decrease in that portion of the field in Ohio was 983,877 barrels, a gain of 721,638 barrels, or 3.09 per cent.

Production of petroleum in the Lima-Indiana field in 1902 and 1903.

State.	Production.		Increase.	Decrease.	Percentage.	
	1902.	1903.			Increase.	Decrease.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*		
Ohio	15,877,730	14,893,853	....	983,877	....	6.196
Indiana	7,480,896	9,186,411	1,705,515	....	22.80	....
Total	23,358,626	24,080,264	721,638	....	3.09	....

WELLS AND STOCKS IN APPALACHIAN AND LIMA-INDIANA FIELDS.

In the tables following are shown the number of wells completed and of dry holes in the Appalachian and Lima-Indiana fields for the years 1902 and 1903:

Number of wells completed and of dry holes in the Appalachian and Lima-Indiana fields in 1902 and 1903, by months.

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

1903.

Month.	Appalachian.		Lima-Indiana.		Total both fields.	
	Completed.	Dry.	Completed.	Dry.	Completed.	Dry.
January	490	139	384	31	874	170
February	513	159	432	39	945	198
March	495	140	493	32	988	172
April	664	159	523	38	1,187	197
May	715	178	710	62	1,425	240
June	839	227	810	72	1,649	299
July	781	194	765	72	1,546	266
August	846	216	823	85	1,669	301
September	814	198	720	56	1,534	254
October	815	223	750	73	1,565	296
November	824	218	733	56	1,557	274
December	678	163	615	59	1,293	222
Total	8,474	2,214	7,758	675	16,232	2,889

Of the entire number of wells drilled in both fields in 1903, 82 per cent were productive, as compared with 80 per cent in 1902, with 78.6 per cent in 1901, and with 80.6 per cent in 1900, which indicates the remarkable character of the general result in securing paying wells. The total number of wells drilled and operated in these two fields during 1903 is estimated at 133,500.

Stocks of petroleum held by pipe lines at close of 1899, 1900, 1901, 1902, and 1903 in the Appalachian and Lima-Indiana fields.

[Barrels of 42 gallons.]

	1899.	1900.	1901.	1902.	1903.
National Transit Co.	7,615,626	8,174,506	5,069,782	1,456,556	1,037,458
Southwest Pennsylvania Pipe Line Co.	1,560,443	1,368,892	865,477	505,270	706,769
Eureka Pipe Line Co	1,593,060	1,401,201	1,465,606	1,440,810	1,009,472
Buckeye Pipe Line Co. (Macksburg oil)	674,583	591,899	476,491	606,492	472,150
Cumberland Pipe Line Co.	....	....	128,574	279,493	408,378
Southern Pipe Line Co	396,256	471,599	391,892	326,448	429,547
Crescent Pipe Line Co.	73,633	103,808	126,052	87,822	154,177
New York Transit Co.	756,120	533,080	330,666	184,804	7,504
Tidewater Pipe Co	294,265	334,308	345,643	418,504	287,782
Producers and Refiners' Oil Co.	140,966	148,769	139,868	283,154	241,987
Elk Oil Co	597	595	628	2,093	....
Emery Pipe Line Co.	25,102	20,252	22,470	25,483	14,128
United States Pipe Line Co.	33,148	25,857	57,271	82,198	53,847
Other lines	287,372	300,832	215,072	42,497	31,516
Total stocks Appalachian field	13,451,191	13,475,548	9,635,492	5,741,624	4,854,715
Total Lima-Indiana stocks	10,545,927	14,988,928	17,760,306	17,306,426	15,138,637
Total both fields	23,997,118	28,464,476	27,395,798	23,048,050	19,993,352

This table shows that the stocks of oil held by various pipe-line companies in iron tanks decreased 3,054,698 barrels in 1903. The whole Appalachian field revealed a decline in the net stocks of 886,909 barrels. The stocks of the Lima oil suffered a reduction of 2,167,789 barrels. Stocks at the close of 1903 were the smallest of the last five years. Since 1900 there has been a decrease in stocks in the eastern and Ohio-Indiana oil regions of 8,471,124 barrels. The Appalachian stocks have been drawn upon very heavily within the five years covered by the above table, owing to the increasing demand for the products of the high grades of oils. In the early eighties, when the production of the great Bradford field was at its zenith, and the Trenton rock districts of Ohio and Indiana were an unknown factor in the petroleum supply, the stock of surplus oil stored in iron tanks rose to 40,000,000 barrels.

RELATIVE POSITION OF PETROLEUM-BEARING FORMATIONS IN THE APPALACHIAN AND LIMA-INDIANA FIELDS.

The following table gives a close approximation to the relative position of all the known productive rock series of the Appalachian and the Lima-Indiana fields, referred to the Pittsburg coal.

The intervals vary greatly in different localities and are only locally productive of petroleum and natural gas. The general section is compiled from well records in the McDonald and the Bradford fields of western Pennsylvania and records of wells in western New York, and represents the consecutive arrangement and relative position of the strata. The composition of the individual strata which produce petroleum varies from rather fine-grained sand to a pebble conglomerate sand, more or less coarse, of the Carboniferous and the Devonian periods, and to the sandy and crystalline limestones of the Silurian period. In southeastern Ohio there is one sandstone known to be productive of petroleum that is 100 feet above the Pittsburg coal, and is known as the Goose Run sand.

Petroleum-producing horizons.

Geological equivalent.	Petroleum-producing horizons.	Locality where productive.	Approximate depth below Pittsburg coal.
			Feet.
Conemaugh or Barren measures XIV.	Pittsburg coal capping	Not productive	0
	Connellsville sand	West Virginia	40
	Morgantown sand	do	80
	Crinoidal limestone	Not productive	300
	"Hurry-up sand"	Southwestern Pennsylvania and West Virginia.	325
Allegheny or lower productive XIII.	Mahoning Dunkard or first Cow Run sand.	do	485
	Second Dunkard sand	Southwestern Pennsylvania, southeastern Ohio, and West Virginia.	525
	Lower Freeport or second Cow Run sand.	do	630
	Ferriferous limestone	Not productive	890
Pottsville XII	Tionesta, Homewood, or Johnson Run sand.	Southwestern Pennsylvania, southeastern Ohio, Kentucky, eastern Kentucky, and West Virginia.	920
	Upper Conoquenessing or upper salt sand.	do	970
	Lower Conoquenessing or middle salt sand.	do	1,050
	Lower salt sand Olean or Sharon conglomerate or Maxon sand.	Southwestern Pennsylvania, southeastern Ohio, West Virginia, Kansas, and Indian Territory.	1,130
Mauch Chunk XI	Mountain limestone	Not productive	1,225
	Keener sand and sandy limestone.	Southeastern Ohio and West Virginia.	1,345

Petroleum-producing horizons—Continued.

Geological equivalent.	Petroleum-producing horizons.	Locality where productive.	Approximate depth below Pittsburg coal.
			Feet.
Pocono X	Big Injun or Sub-Olean sand	Southwestern Pennsylvania, southeastern Ohio, West Virginia, and eastern Kentucky.	1,375
	Squaw sand	do	1,465
Upper Devonian VIII	Upper gas sand	Southwestern Pennsylvania	1,535
	Berea or Butler County gas sand.	Southwestern Pennsylvania, southeastern Ohio, West Virginia, and Kentucky.	1,730
	Devonian or Ohio shales	Not productive; produces gas.	
	First or Gantz sand (100-foot sand upper portion).	Western Pennsylvania, southwestern Ohio, and West Virginia.	1,850
	Red Valley sand or 50-foot sand. (100-foot sand lower portion.)	Western Pennsylvania and West Virginia.	1,885
	Second or 30-foot sand	do	2,010
	Gray, Stray, or Bowlder sand	do	2,070
	Third or Gordon sand	Western Pennsylvania, southeastern Ohio, and West Virginia.	2,130
	Stray third sand	Western Pennsylvania and West Virginia.	2,145
	Fourth sand	Southwestern Pennsylvania and West Virginia.	2,200
	Fifth sand	do	2,260
	Bayard sand	Northern West Virginia and southwestern Pennsylvania.	2,420
	Elizabeth or sixth sand		2,590
	Warren first sand	Northwestern Pennsylvania	2,700
	Warren second sand	do	2,815
	Clarendon or Tiona sand	do	2,905
Lower Devonian VIII.	Speechley sand	do	3,020
	Balltown, Cherry Grove, or Garfield sand.	Northeastern Pennsylvania and western New York.	3,150
	Sheffield or Gusher City sand	do	3,350
	Deer Lick sand	do	3,420
	Bradford sand	do	3,460
	Elk sand or Waugh and Porter sand.	do	3,670
	Kane sand	do	3,860
	Corniferous limestone	Northeastern and central Ohio, western New York, and Ontario, Canada.	5,625
Silurian	Clinton limestone	Central Ohio and Kentucky	6,000
Ordovician	Trenton limestone	Northwestern Ohio, Indiana, and Kentucky.	8,700
Cambrian	Sands and shales	Northwestern Newfoundland	9,230

EXPORTS.

The following tables are the official statement by the Bureau of Statistics of the quantity and value of petroleum and its products (mineral oils) exported from ports and districts in the United States for the year ending December 31, 1903, as compared with the preceding year:

Exports of mineral oils from the United States in 1902 and 1903.

Port and kind.	1902.		1903.	
	Gallons.	*Value.*	*Gallons.*	*Value.*
CRUDE.				
Boston and Charlestown	....	....	5,000	$450
Delaware	98,306,742	$4,768,012	94,260,271	5,280,778
New York	499,616	28,898	6,542	406
Philadelphia	26,837,777	1,382,816	15,414,523	989,675
Galveston	18,430,353	109,326	12,298,357	260,440
Other districts	1,159,235	41,959	4,526,994	250,387
Total	145,233,723	6,331,011	126,511,687	6,782,136
NAPHTHA.				
Baltimore	....	....	1,800	361
Boston and Charlestown	....	....	630	104
Delaware	....	....	33,547	3,083
New York	10,598,990	945,247	7,423,541	944,431
Philadelphia	7,152,106	290,458	4,206,068	425,572
Galveston	297,174	4,275	....	....
Other districts	1,634,367	152,791	1,308,567	144,990
Total	19,682,637	1,392,771	12,973,153	1,518,541
ILLUMINATING.				
Baltimore	40,426,380	2,812,779	34,885,961	2,495,465
Boston and Charlestown	594,132	57,329	670,106	80,070
Delaware	6,000	519	130,927	11,960
New York	459,963,722	30,522,742	361,687,183	29,086,370
Philadelphia	262,096,870	14,619,604	270,212,278	18,056,258
Galveston	2,824,883	81,778	4,711,964	143,159
Other districts	12,888,991	984,304	19,588,795	1,480,396
Total	778,800,978	49,079,055	691,837,234	51,355,668
LUBRICATING AND PARAFFIN.				
Baltimore	1,143,772	135,297	2,314,770	267,246
Boston and Charlestown	127,727	22,454	104,635	18,621
New York	54,028,524	8,128,584	66,429,994	9,591,421
Philadelphia	24,633,086	2,170,108	24,633,928	2,436,512
Galveston	....	....	30,563	3,555
Other districts	2,267,394	415,761	2,108,061	372,710
Total	82,200,503	10,872,154	95,621,941	12,690,065
RESIDUUM.				
Boston and Charlestown	11,550	1,018	27,090	1,562
New York	9,013,116	241,757	2,452,128	71.885
Philadelphia	23,865,428	619,527	2,497,320	59,988
Galveston	5,114,465	46,270	3.859,425	113,472
Other districts	311,201	13,580	917,277	35,222
Total	38,315,760	922,152	9,753,240	282,129
Grand total	1,064,233,601	68,597,143	986,697,255	72,628,539

Exports of mineral oils from the United States in 1902 and 1903—Continued.

RECAPITULATION BY KINDS.

Port and kind.	1902.		1903.	
	Gallons.	*Value.*	*Gallons.*	*Value.*
Crude petroleum	145,233,723	$6,331,011	126,511,687	$6,782,150
Naphtha	19,682,637	1,392,771	12,973,153	1,518,541
Illuminating oil	778,800,978	49,079,055	691,837,234	51,355,668
Lubricating oil and paraffin	82,200,503	10,872,154	95,621,941	12,690,051
Residuum	38,315,760	922,152	9,753,240	282,129
Total	1,064,233,601	68,597,143	936,697,255	72,628,589

RECAPITULATION BY PORTS.

Port	1902 Gallons	1902 Value	1903 Gallons	1903 Value
Baltimore	41,570,152	$2,948,076	37,202,551	$2,763,072
Boston and Charlestown	733,409	80,801	807,461	100,807
Delaware	98,312,742	4,768,531	94,424,745	5,295,811
New York	534,103,968	39,867,178	437,999,388	39,694,518
Philadelphia	344,585,267	19,082,518	316,963,117	21,970,005
Galveston	26,666,875	241,649	20,900,309	520,626
Other districts	18,261,188	1,608,395	28,399,684	2,283,705
Grand total	1,064,233,601	68,597,143	936,697,255	72,628,539

Exports of mineral oils from the United States, 1887–1903.

[Gallons.]

Year.	Crude.	Naphtha.	Illuminating.	Lubricating and paraffin.	Residuum.	Total. Quantity.	Total. Value.
1887	80,643,839	12,344,669	464,702,903	20,340,820	2,989,098	581,021,329	$45,231,988
1888	77,887,799	13,466,234	450,801,683	24,280,826	1,861,104	567,797,646	47,563,749
1889	84,144,196	13,958,965	548,496,241	27,754,239	1,837,794	676,191,455	52,792,478
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	11,898,085	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	749,805,844	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	138,161,173	18,570,488	739,163,464	71,211,353	19,749,996	986,856,474	74,493,707
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
1903	126,511,687	12,973,153	691,837,234	95,621,941	9,753,240	936,697,255	72,628,539

This table indicates the remarkable steady trade in our exportation of crude petroleum and its products over a series of years, although the exportation for 1903 shows a considerable falling off in the quantity of crude, naphtha, illuminating, and residuum exported. The quantity of lubricating petroleum exported, on the other hand, shows a large increase. The value of the entire quantity exported shows an increase, as compared with 1902, of about $4,000,000.

The following table gives the quantity in gallons and the value for each month during the last four years:

Exports of mineral oil from the United States in years 1900–1903, by months.

Month.	1900.		1901.	
	Gallons.		Gallons.	
January	76,001,193	$6,426,014	86,664,193	$5,819,965
February	65,181,888	5,619,021	65,538,129	4,539,727
March	75,950,707	6,609,705	75,197,239	5,417,065
April	69,056,431	6,130,458	87,932,625	6,251,802
May	84,895,969	6,867,580	98,677,736	6,576,904
June	79,842,430	5,872,630	85,156,212	5,538,966
July	90,902,917	6,286,090	99,415,209	6,373,491
August	104,017,828	7,393,490	93,502,384	6,266,383
September	89,689,052	6,517,837	102,177,175	6,738,977
October	95,191,183	6,278,457	91,267,756	6,464,606
November	76,454,544	5,254,562	95,652,943	6,296,115
December	79,672,332	5,237,863	97,892,918	6,498,849
Total	986,856,474	74,493,707	1,079,074,519	72,784,912

Month.	1902.		1903.	
	Gallons.		Gallons.	
January	95,043,650	$6,064,804	59,728,465	$4,640,980
February	66,481,793	4,390,794	70,957,459	5,128,788
March	88,483,621	5,512,559	63,709,151	4,822,125
April	88,970,138	5,775,468	78,776,378	6,157,035
May	90,324,733	6,048,791	78,194,996	5,987,375
June	96,997,150	5,869,983	74,659,397	5,582,486
July	86,633,444	5,662,837	87,005,600	6,336,286
August	89,853,637	5,563,917	80,412,826	5,949,247
September	82,268,037	4,953,792	87,935,631	6,574,333
October	100,990,406	6,557,263	84,675,226	7,052,394
November	83,554,869	5,485,884	82,715,599	6,756,802
December	94,632,123	6,711,051	87,926,527	7,640,688
Total	1,064,233,601	68,597,143	936,697,255	72,628,589

The following table exhibits the total production of crude petroleum in 1903, 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 1903, inclusive.

Year ending December 31—	Production.		Exports.			
			Mineral, crude (including all natural oils, without regard to gravity).		Mineral, refined or manufactured.	
	Barrels (of 42 gallons).	Gallons.			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	19,643,740	2,665,171	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	45,011,154	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	6,040,685	14,739,469	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	5,141,838	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
1893a	48,412,666	2,033,331,972	111,703,508	4,567,391	17,304,005	1,074,710
1894a	49,344,516	2,072,469,672	121,926,349	4,415,915	15,555,754	948,970
1895a	52,892,276	2,221,475,592	111,285,264	5,161,710	14,801,224	910,988
1896a	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	1,063,231
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	138,161,173	7,340,749	18,570,488	1,681,201
1901	69,389,194	2,914,346,148	127,008,002	6,087,544	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
1903	100,461,337	4,219,376,154	126,511,687	6,782,136	12,973,153	1,518,541

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, 508,886 barrels were produced, but not marketed.

Quantity of crude petroleum produced in, and quantities 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	$92,406
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	998,068	269,886
1875	208,678,748	28,168,572	988,052	265,887
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	718,206
1880	286,131,557	29,047,908	5,607,009	1,141,825
1881	444,666,615	42,122,683	5,053,862	1,165,606
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	483,851,275	39,450,794	11,985,219	2,443,385
1885	445,880,518	39,476,062	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	456,045,784	37,236,111	24,510,437	4,215,449
1889	551,769,666	41,215,192	27,903,267	4,698,724
1890	550,873,488	39,826,086	32,090,537	4,766,850
1891	581,445,099	34,879,759	33,310,264	4,990,978
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	5,449,900
1895 [a]	714,859,1[illegible]	34,706,644	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	7,335,054
1899	724,562,993	48,466,200	69,329,188	8,344,735
1900	739,163,464	54,692,872	71,211,353	9,988,548
1901	827,479,493	58,490,713	75,305,938	10,260,136
1902	778,800,978	49,079,065	82,200,503	10,872,154
1903	691,837,234	51,355,668	95,621,941	12,690,665

[a] Exports are for fiscal years from 1893 to 1896, inclusive.

Quantity of crude petroleum produced in, and quantities 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	57,539,878
1878	3,126,816	220,835	349,346,253	41,022,007
1879	4,827,522	273,060	421,719,782	37,235,467
1880	3,177,680	198,983	346,779,443	34,505,645
1881	3,756,018	197,321	514,561,719	48,556,108
1882	4,260,352	275,263	503,492,462	44,623,074
1883	6,502,524	465,350	533,145,429	47,768,079
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	2,969,098	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	966,480,610	52,551,048
1899	21,544,278	655,878	951,024,441	64,982,249
1900	19,749,996	845,337	986,856,474	74,493,707
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
1903	9,753,240	282,129	936,697,255	72,628,589

[a] Exports are for fiscal years from 1893 to 1896, inclusive.

Production of petroleum in the Appalachian oil field, 1889–1903, 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
1903	12,518,134	12,899,395	5,586,433	554,286	31,558,248

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 1897 to 1903, by months:

Production of crude petroleum in the Appalachian oil field, 1897–1903, by months and years.

[Barrels of 42 gallons.]

Month.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	2,754,788	2,816,744	2,492,679	2,918,175	3,003,285	2,614,845	2,726,634
February	2,663,433	2,466,179	2,285,466	2,595,900	2,567,288	2,253,491	2,353,231
March	2,935,595	2,864,640	2,736,784	3,004,813	2,916,677	2,629,104	2,759,807
April	2,809,175	2,689,463	2,642,830	2,950,469	2,862,813	2,664,668	2,691,431
May	2,902,598	2,714,522	2,825,254	3,148,944	2,963,001	2,759,717	2,681,565
June	2,990,516	2,595,599	2,796,098	3,068,693	2,751,409	2,598,349	2,731,722
July	3,035,361	2,573,112	2,845,149	3,100,319	2,921,520	2,825,398	2,756,306
August	3,115,402	2,668,438	3,001,267	3,198,715	2,941,578	2,728,825	2,628,708
September	3,035,348	2,579,174	2,839,983	3,002,998	2,644,108	2,769,060	2,633,513
October	3,078,068	2,581,690	2,920,530	3,245,506	2,814,972	2,860,506	2,664,422
November	2,983,642	2,527,950	2,863,429	3,009,508	2,590,781	2,609,453	2,374,373
December	2,926,325	2,639,914	2,818,887	3,051,398	2,640,744	2,705,371	2,554,463
Total	35,230,271	31,717,425	33,068,356	36,295,433	33,618,171	32,018,787	31,558,248

AVERAGE DAILY PRODUCTION OF APPALACHIAN FIELD, 1897–1903, BY MONTHS AND YEARS.

In the following table is given the average daily production in the Appalachian oil field from 1897 to 1903, by months and years:

Average daily production of crude petroleum in the Appalachian oil field each month, 1897–1903, by months and years.

[Barrels of 42 gallons.]

Month.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	88,864	90,863	80,422	94,135	96,880	84,350	87,956
February	95,123	88,076	81,618	92,711	91,689	80,482	84,046
March	94,696	92,407	88,283	96,929	94,086	84,810	89,026
April	98,639	89,648	88,092	98,349	95,427	88,822	89,714
May	98,632	87,565	91,137	101,579	95,581	89,023	86,508
June	99,684	86,519	93,202	102,290	91,714	86,612	91,057
July	97,915	83,008	91,779	100,010	94,243	91,142	88,978
August	100,497	86,079	96,815	103,184	94,890	88,027	84,797
September	101,178	85,972	94,664	100,100	88,137	92,302	87,784
October	99,298	83,280	94,210	104,694	90,806	92,274	85,949
November	99,455	84,264	95,446	100,817	86,359	86,982	79,146
December	94,398	85,158	90,932	98,432	85,185	87,270	82,402
Average	96,521	86,897	90,598	99,440	92,106	87,723	86,461

Average monthly prices of Appalachian crude petroleum in 1902 and 1903.

[Per barrel of 42 gallons.]

Month.	1902.				1903.	
	Tiona.	Pennsylvania.	Corning.	Newcastle.	Tiona.	Pennsylvania.
January	$1.30	$1.15	$0.98	$0.90	$1.67½	$1.52½
February	1.30	1.15	.98	.90	1.65	1.50
March	1.30	1.15	.98	.90	1.65	1.50
April	1.32½	1.17½	1.00½	.92½	1.66	1.51
May	1.35	1.20	1.03	.95	1.66½	1.51½
June	1.35⅝	1.20⅝	1.03⅝	.95⅝	1.65	1.50
July	1.37	1.22	1.05	.97	1.67½	1.52½
August	1.37	1.22	1.05	.97	1.71	1.56
September	1.37	1.22	1.05	.97	1.72¼	1.57¼
October	1.43½	1.28½	1.11½	1.03½	1.83½	1.68½
November	1.58¼	1.38¼	1.21¼	1.13¼	1.93¾	1.78¾
December	1.64	1.49	1.29½	1.33¾	2.03½	1.88½
Average	1.38¾	1.23¾	1.06½	.99½	1.74	1.59

PETROLEUM AND GAS PRODUCING ROCKS OF OHIO.

The following arrangement of the petroleum and natural gas-bearing rocks of Ohio is taken from the report of the geological survey of Ohio for 1903, compiled by Prof. John Adams Bownocker. These rocks have great range stratigraphically. The Trenton limestone is the lowest and the Monongahela formation, or the Upper Productive Coal Measures, the highest. Between these extremes a large number of formations exist which produce oil or gas in commercial quantities. These rocks differ greatly in their chemical and physical properties.

Petroleum and gas bearing formations in Ohio.[a]

Carboniferous	Coal measures	Goose Run sand.	
		Mitchell sand.	
		First Cow Run sand.	
		Macksburg 500-foot sand.	
		Second Cow Run sand.	
		Pottsville conglomerate.	Salt sand.
			Maxton sand.
	Lower Carboniferous	Maxville limestone	Mountain lime.
		Logan group	Keener sand.
			Big Injun sand.
			Squaw sand.
		Berea grit.	
Devonian		Ohio shales.	
Silurian		Lower Helderberg sand.	
		Clinton sand.	
Ordovician		Trenton limestone.	

INDIANA.

This State made, under the stimulation of the high prices paid, remarkable gains in the production of crude petroleum during 1903. No new pools were opened, except that in the latter part of the year a small pool of dark, heavy petroleum was partly developed near Princeton, in Gibson County, near the southeastern corner of the State. Nearly all of the increased production was secured by wells inside of defined limits, and in sections where the natural-gas pressure had decreased until it was of no great importance and the gas pools had in some instances been developed into petroleum-producing areas. It is a field of easy access, being abudantly supplied with pipe lines and other facilities for producing petroleum profitably.

Indiana produced in 1903 the unprecedented output of 9,186,411 barrels, nearly all from the Trenton limestone, valued at $10,474,127, an increase in quantity of 1,705,515 barrels, or 22.8 per cent, and in value of $3,947,505, or 60.5 per cent, as compared with 1902. The price per barrel rose from $0.872 in 1902 to $1.14 in 1903, a gain of 26.8 cents per barrel. This State produced 9.14 per cent of the total output of the United States in 1903, and 11.06 per cent of the total value, the value of the Indiana output being more than 3 per cent greater than the value of the product of either Texas or California.

The total number of wells drilled in 1903 was 3,693, of which number only 380 were dry holes and 3,313 were productive wells, the dry wells representing only 10.3 per cent in 1903, as compared with 15 per cent in 1902 and with 16 per cent in 1901. The average initial production of new wells per month in 1903 was 4,250 barrels, as compared with 3,772 barrels in 1902.

The increased production was well maintained throughout the State, and in numerous instances new pay streaks were found deeper in the Trenton limestone. One of the serious drawbacks connected with the operation of wells in this State is the immense quantity of salt water that it is necessary to pump to secure and maintain the production. In some localities 20 barrels of salt water are pumped for one barrel of petroleum produced. The economical and efficient natural-gas engine enables this great expenditure of power to be applied at a reasonable expense.

Outside of the well-developed areas of the Trenton limestone there are a few smaller pools in the State which have produced some petroleum, but nothing to compare in quantity to the original field. There are small producing areas in Jasper, Vigo, and Dubois counties in which the Corniferous limestone is productive. In Gibson County several small wells were developed during the latter portion of the year near Princeton which gave a production of from 5 to 15 barrels of heavy, dark petroleum from a formation corresponding to the lower Salt sand or Maxon sand of West Virginia, but known as the Mansfield sand in Indiana, and resting upon the Subcarboniferous limestone. All the well sections in this portion of southern Indiana show a very remarkable thinning out of the formation, as the distance from the bottom of the Mansfield sand or Salt sand to the top of the Corniferous limestone near the bottom of the Devonian is less than 550 feet, as compared with an interval of about 4,500 feet between the same horizons in western Pennsylvania.

The following geological table was compiled by Mr. T. C. Hopkins, of the Indiana State geological survey, Twenty-eighth Annual Report, 1903, in which the sequence of the general geological scale is given. The upper and lower members of the scale are wanting in Indiana, and the lowest members named are only pierced by the drill within the borders of the State, and are therefore marked as uncertain in their equivalents. The equivalents in Pennsylvania and New York and in the Mississippi Valley are also named.

Geological table. [a]

Era.	Period.	Indiana.	Correlation. Pennsylvania and New York.	Correlation. Mississippi Valley.
Cenozoic	Quaternary-Pleistocene.	Recent.		
		Glacial.		
	Teritiary.			
Mesozoic	Cretaceous.			
	Jurassic.			
	Triassic.			
Paleozoic	Permo-Carboniferous	Merom-sandstone	Upper barren.	
			Upper productive.	
		Productive coal measures.	Lower barren.	
			Lower productive.	
		Mansfield sandstone	Pottsville conglomerate.	Millstone grit.
	Mississipian or Lower Carboniferous.	Huron		Chester-Kaskaskia.
		Mitchell		St. Louis.
		Bedford oolitic	Mauchchunk	Warsaw.
		Harrodsburg		Burlington.
		Knobstone		Keokuk.
		Goniatite		Chouteau.
	Devonian	New Albany	Genessee.	
		Sellersburg	Hamilton.	
		Silver Creek	Hamilton.	
		Jeffersonville	Corniferous.	
		Pendleton	Schoharie.	
		Water lime	Lower Helderburg (?), Salina.	
	Silurian	Louisville.		
		Waldron.		
		Laurel	Niagara.	
		Osgood	Niagara.	
		Clinton.		
	Ordovician (Lower Silurian).	Richmond	Hudson River.	
		Lorraine	(Cincinnati.)	
		Utica.		
		Trenton.		
		St. Peter's (?)	Chazy.	
		Lower magnesian (?).	Calciferous.	
Azoic	Cambrian	Potsdam (?)	Huronian.	
	Algonkian (?).			
	Archean		Laurentian.	

[a] Indiana, Department Geology and Nat. Resources, 28th Ann. Rept., 1903, p. 17.

KANSAS.

The developments of petroleum in this State during 1903 has shown that, in addition to the area already known, an immense area of profitable territory exists in southeastern Kansas and extends over into Indian and Oklahoma Territories. The physical conditions surrounding this field have proven to be very similar in many particulars to those of the original Pennsylvania field, except that the surface is more level. The petroleum is found in pools of greater or less extent, associated with natural gas over many square miles of area and not in concentrated pools containing from 200 to 250 acres, as is the case at Spindle Top and Sour Lake in Texas.

The quantity of petroleum produced would have been considerably larger had the pipe lines been in condition to handle it as they did during the last five months of the year. Shippers by rail to Neodesha were obliged to submit to a reduction of 23 cents per barrel, which in many cases was prohibitive. The production at the close of the year was about six times as great as it was at the beginning, which shows the wonderful increase.

Beginning with Humboldt, in Allen County, there seems to be an almost continuous pool to the southwest passing through the counties of Neosho, Wilson, Montgomery, and Chautauqua to the State line, where it joins that of Indian and Oklahoma Territories, an area 65 miles in length with an average width of 20 miles, although at some points the distance between developed local pools of petroleum and natural gas is much greater.

The production is from a sandstone formation, generally known as a "sugar sand," usually from 15 to 30 feet in thickness. The general dip is to the west and southwest. The wells in the northern portion of the pool in Allen County are about 700 feet in depth, and they increase in depth with the general trend of the development. The gravity and quality of the petroleum produced increase with the depth of the petroleum-bearing sandstone. No very large flowing wells have been developed; but a large number of wells that produce from 10 to 50 barrels per day with remarkable regularity have been secured, which can be cheaply operated with natural gas.

There has been a great increase in the length of pipe lines and in the number of storage tanks completed during the latter part of the year, and nearly all of the pools have been connected by pipe line with the refinery at Neodesha, which has been greatly enlarged to take care of the increased production. A very large area has been leased by individuals and companies, and drilling has been most actively pushed. Fully 1,400 wells have been completed during the year, about four times as many as was completed in 1902. In no other locality in the petroleum fields has there been such activity as there was in Kansas and in Indian and Oklahoma Territories during 1903. The quality of some of the petroleum produced in Kansas is equal, if not superior, to that of the Lima-Indiana field, and the indications are that the year 1904 will witness a production of about 4,800,000 barrels from this section.

PRODUCTION IN KANSAS.

The production for 1903 was 932,214 barrels, as compared with 331,749 barrels in 1902, an increase of 600,465 barrels or about 181 per cent. In rank of production in 1903 Kansas was eighth, and produced 0.93 per cent of the total output of the United States; in 1902 Kansas was tenth in rank, and produced 0.38 per cent of the total for that year. When the value of the production is considered, Kansas occupied eighth place and produced 1.04 per cent of the total value in 1903, as compared with ninth place and 0.41 per cent of the total value in 1902.

The average price for the Kansas production in 1903 was $1.06 per barrel, as compared with 88 cents in 1902, a gain of 18 cents per barrel. The highest price obtained was for the oil produced at Independence, which averaged $1.30½ per barrel. The petroleum from the Chanute district, which produced over 60 per cent of the total, brought an average of 99⅛ cents per barrel. The lowest price paid was 60 cents per barrel for the heavy petroleum produced in the Humboldt district.

CHEMICAL AND PHYSICAL EXAMINATION OF KANSAS PETROLEUM.

Profs. Edward Bartow and Elmer McCollum, of the State University, have recently published three articles in the Kansas Derrick on the chemistry of Kansas petroleum, and from these accounts the following table is taken:

Chemical and physical examination of Kansas petroleum.

Number of sample.	Specific gravity.	Baumé.	Flash point.		Burning point.	
			Fahrenheit.	Centigrade.	Fahrenheit.	Centigrade.
			°	°	°	°
1	0.866	32.5	52	11	77	25
2	.872	31.3	112	39	129	54
3	.940	19.3	289	143	360	172
4	.906	25	167	75	208	98
5	.912	24	160	71	241	116
6	.880	30	52	11	124	51
7	.874	31	52	11	79	26
8	.875	31	77	25	124	51
9	.857	33.5	Ordinary temperature.		Ordinary temperature.	
10	.858	33.8	do		do	
11	.741	59.5	do		do	
20	.846	35.6	do		64	18
29	.845	35.7	Below 50.	Below 10.	Below 50.	Below 10.
30	.862	32.4	do	do	102	39
33	.923	21.9	163	73	203	95
35	.974	13.8				
22	.865	32	Ordinary temperature.		102	39
18	.846	25.6	do		63	17

Nos. 1 and 2 are from Chanute; Nos. 3, 5, 6, 7, and 8 are from Humboldt; No. 4 is from La Harpe; No. 9 is from Cherryvale; Nos. 10 and 11 are from Independence; No. 20 is from Neodesha; No. 29 is from Caney; No. 30 is from Peru; No. 33 is from Beaumont, Tex.; No. 35 is from Keen River, California; No. 22 is from Bartlesville, Ind. T., and No. 18 is from Lima, Ohio.

The total production of oil in Kansas, so far as records have been obtained, is as follows:

Production of petroleum in Kansas, 1889–1903.

Year.	Quantity.	Year.	Quantity.
	Barrels.		*Barrels.*
1889	500	1897	81,098
1890	1,200	1898	71,980
1891	1,400	1899	69,700
1892	5,000	1900	74,714
1893	18,000	1901	179,151
1894	40,000	1902	331,749
1895	44,430	1903	932,214
1896	113,571		

The following table gives the monthly production in Kansas from 1898 to 1903:

Production of crude petroleum in Kansas, 1898–1903, by months.

[Barrels of 42 gallons.]

Month.	1898.	1899.	1900.	1901.	1902.	1903.
January	7,602	5,843	5,061	9,466	19,684	37,382
February	6,384	5,531	4,442	9,675	18,079	36,431
March	6,562	5,956	4,901	13,000	19,877	25,877
April	6,973	5,374	4,828	14,435	19,523	20,134
May	6,186	5,788	5,242	18,706	18,468	59,488
June	6,570	5,581	5,834	16,469	19,142	44,532
July	5,259	5,701	6,455	16,427	20,373	44,320
August	5,587	6,633	7,873	13,996	22,475	83,286
September	4,723	6,112	6,356	14,274	23,575	105,891
October	5,457	5,956	8,408	18,411	38,156	113,683
November	5,224	5,622	7,259	16,618	54,490	151,031
December	5,508	5,603	9,055	17,674	58,407	210,659
Total	71,980	69,700	74,714	179,151	331,749	932,214

The production recorded in this table for the last five months of 1903 indicates the rapid development made in marketing the petroleum, much of which was held in tanks and not pumped from the wells until in August, when the pipe lines were enabled to give some relief.

Production of crude petroleum in Kansas in 1903, by months and districts.

[Barrels of 42 gallons.]

Month.	Neodesha.	Chanute.	Humboldt.	Peru.	Independence.	Cherryvale.	Total.
January	7,440	25,812	....	2,975	....	1,155	37,382
February	6,328	26,292	....	2,846	....	965	36,431
March	7,586	12,812	....	3,773	....	1,206	25,377
April	6,706	9,966	....	3,036	....	426	20,134
May	9,306	46,084	431	2,634	....	1,083	59,488
June	6,886	34,494	145	2,134	....	923	44,582
July	6,391	34,482	578	2,134	....	735	44,320
August	10,838	67,822	....	3,273	....	1,353	83,286
September	9,901	82,850	1,744	4,931	5,760	705	105,891
October	12,529	75,142	6,080	2,952	15,297	1,683	113,683
November	13,797	69,266	12,053	9,767	44,144	2,004	151,031
December	13,867	75,029	18,994	23,159	78,711	899	210,659
Total	111,525	560,001	40,025	63,614	143,912	13,137	932,214

It will be observed in the above table that the Chanute district produced more than one-half of the output in 1903, and that the new pool at Independence was made a separate district in September.

Stocks of petroleum held by pipe line company in Kansas at close of each month in 1902 and 1903.

[Barrels.]

Month.	1902.	1903.	Month.	1902.	1903.
January	76,092	151,101	July	68,521	257,197
February	74,806	164,059	August	70,982	328,101
March	73,887	163,311	September	84,388	405,908
April	68,542	165,572	October	98,982	464,528
May	69,596	175,771	November	119,928	568,864
June	68,460	201,184	December	126,268	718,757

In addition to this, there is a large quantity of petroleum stored in tanks of companies and individuals that the pipe lines have been unable to handle.

WELL RECORDS IN KANSAS.

Number of producing oil wells in Kansas at close of each year, 1897–1903, by counties.

County.	December 31—						
	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Allen	....	1	....	....	....	86	227
Chautauqua	....	3	3	4	6	10	106
Montgomery	1	1	1	1	2	16	107
Neosho	16	17	16	25	51	170	478
Wilson	54	64	65	78	100	108	227
Woodson	....	....	....	....	1	1	....
Total	71	86	85	108	160	a391	b1,145

a This total includes 83 wells which were not pumped in 1902.
b Number of wells connected to pipe line.

One hundred companies were producing and shipping crude petroleum by pipe line in Kansas at the close of 1903.

The following table is a record for the last eight months in 1903 of wells completed, producing, dry, and drilling, and of rigs building in Kansas and Indian and Oklahoma Territories:

Well record in Kansas and Indian and Oklahoma Territories in 1903.

WELLS COMPLETED IN 1903.

District.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Neodesha	....	5	34	18	35	18	29	39	23	....
Chanute	....	16	23	45	16	25	25	81	56	....
Humboldt	....	12	52	14	35	65	68	44	65	....
Peru	....	5	13	9	30	32	25	30	29	....
Independence	....	6	4	10	36	8	32	49	25	....
Cherryvale	....	....	4	4	10	....	....	18	2	....
Bartlesville	....	5	4	7	8	13	5	12	6	....
Redfork	....	....	1	2	....	....	....	3	....	....
Total	....	49	135	109	170	161	184	276	206	....

WELLS PRODUCING ON 31ST OF EACH MONTH.

District.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Neodesha	....	148	139	162	175	197	210	230	280	....
Chanute	....	207	229	250	351	367	392	416	549	....
Humboldt	....	62	81	133	147	165	209	262	339	....
Peru	....	15	20	32	40	60	81	102	151	....
Independence	....	2	4	7	10	28	32	53	111	....
Cherryvale	....	....	14	18	21	30	30	30	49	....
Bartlesville	....	29	31	34	40	47	57	62	77	....
Redfork	....	....	....	1	3	3	3	3	6	....
Chelsea	....	....	....	....	....	....	....	....	28	....
Total	....	463	518	637	787	897	1,014	1,158	1,590	....

WELLS DRILLING.

District.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Neodesha	15	7	19	16	21	22	24	26	21	....
Chanute	9	11	11	6	13	13	17	32	39	....
Humboldt	20	11	7	12	5	16	30	37	30	....
Peru	5	4	24	13	34	45	38	30	39	....
Independence	5	1	4	18	15	24	10	24	33	....
Cherryvale	....	....	3	1	4	7	7	5	3	....
Bartlesville	2	5	7	7	9	8	6	10	10	....
Redfork	....	....	2	....	....	....	....	....	....	....
Chelsea	....	....	....	....	....	....	....	....	....	....
Total	56	39	77	73	101	135	132	164	175	....

Well record in Kansas and Indian and Oklahoma Territories in 1903—Continued.

WELLS DRY OR NONPRODUCTIVE.

District.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Neodesha	....	....	11	5	12	5	9	2	10	54
Chanute	....	....	2	....	....	....	1	2	2	7
Humboldt	....	....	....	....	17	21	15	16	16	85
Peru	....	....	1	1	10	11	4	7	8	37
Independence	....	4	1	7	18	4	11	10	6	61
Cherryvale	....	....	....	1	1	....	....	1	....	3
Bartlesville	....	3	1	1	1	3	....	2	1	12
Redfork	....	....	....	....	....	....	....	....	....	....
Chelsea	....	....	....	....	....	....	....	....	5	5
Total	....	7	16	15	59	44	40	40	43	264

RIGS BUILDING.

District.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Neodesha	....	2	7	7	3	2	2	2	6	....
Chanute	6	....	2	5	3	3	....	8	17	....
Humboldt	....	....	1	1	....	....	9	6	5	....
Peru	1	6	1	4	5	....	3	4	2	....
Independenee	....	....	1	4	1	11	1	18	36	....
Cherryvale	....	....	....	1	1	....	....	....	....	....
Bartlesville	1	1	8	4	1	6	....	3	8	....
Total	8	9	20	26	14	22	15	41	74	....

PRICES IN KANSAS AND INDIAN TERRITORY.

Range of prices paid for crude petroleum at wells in Kansas and Indian Territory in 1903, by districts.

Date.	Neodesha.	Chanute.	Humboldt.	Peru.	Independence.	Cherryvale.	Bartlesville.
January 1	$1.15	$0.95	....	$0.94	....	$0.95	$0.93
April 22	1.16	.96	....	.95	....	.96	.94
May 16	1.14	.94	....	.93	....	.94	.92
July 16	1.16	.96	....	.95	....	.96	.94
July 23	1.18	.98	....	.97	....	.98	.96
September 28	1.20	1.00	....	.99	....	1.00	.98
September 30	1.22	1.02	....	1.01	....	1.02	1.00
October 8	1.24	1.04	$0.60	1.03	$1.09	1.04	1.02
October 13	1.26	1.06	.60	1.05	1.11	1.06	1.04
October 17	1.28	1.08	.60	1.07	1.28	1.08	1.06
October 24	1.30	1.10	.60	1.09	1.30	1.10	1.08
October 28	1.32	1.12	.60	1.32	1.32	1.12	1.10
November 20	1.35	1.15	.60	1.35	1.35	1.15	1.13
December 2	1.37	1.17	.60	1.37	1.37	1.17	1.15
December 9	1.38	1.18	.60	1.38	1.38	1.18	1.16
December 29	1.36	1.16	.60	1.36	1.36	1.86	1.14

Average prices of crude petroleum per barrell at wells in Kansas and Indian Territory in 1903, by months and districts.

Month.	Neodesha.	Chanute.	Humboldt.	Peru.	Independence.	Cherryvale.	Bartlesville.
January	$1.15	$0.95	....	$0.94	....	$0.95	$0.93
February	1.15	.95	....	.94	....	.95	.93
March	1.15	.95	....	.94	....	.95	.93
April	1.15¼	.95¼	....	.94¼	....	.95¼	.93¼
May	1.15	.95	....	.94	....	.95	.93
June	1.14	.94	....	.93	....	.94	.92
July	1.15⅛	.95⅛	....	.94⅛	....	.95⅛	.93⅛
August	1.18	.98	....	.97	....	.98	.96
September	1.18¼	.98¼	....	.97¼	....	.98¼	.96¼
October	1.26⅝	1.06⅝	$0.60	1.08⅝	$1.22¼	1.06⅝	1.04⅝
November	1.33	1.13	.60	1.33	1.33	1.13	1.11
December	1.37⅞	1.17⅞	.60	1.37⅞	1.37⅞	1.19⅞	1.15⅞
Average	1.19¾	.99⅜	.60	1.02⅝	1.30¾	1.00	.97⅜

INDIAN AND OKLAHOMA TERRITORIES.

The extension of the Kansas pool into Indian and Oklahoma Territories has been known for a number of years, but owing to the complications in the laws governing leases in both of these Territories comparatively little has been done in the way of development until during the year 1903. The developments so far have shown Indian Territory to contain a very large area of petroleum, some of which is of superior quality, nearly equal to that of Pennsylvania. A number of flowing wells were drilled near Bartlesville and at other localities during 1903, which brought up the production by leaps and bounds, with the possibilities only just beginning to be realized. The tables of prices paid, wells drilled, etc., under Kansas, show the districts of Bartlesville, Redfork, and Chelsea, in Indian Territory. The present pipe-line system connects Bartlesville with Neodesha, Kans. The total production in Indian Territory in 1903 was 138,801 barrels, and 110 barrels were produced in Oklahoma, making a total of 138,911 barrels, which sold for $142,402, at an average price of $1.02½ per barrel. There was a gain of 101,811 barrels over the production of 1902, an increase of 274.42 per cent. At the close of the year there were about 110 wells producing, but many were shut in on account of the want of transportation. There were 10 wells drilling. The producing sand at Bartlesville lies about 1,250 feet below the surface.

The production in Oklahoma Territory was only 110 barrels from 3 wells, which is probably the mere beginning of the operations in this Territory. There is no doubt that much of the northeastern portion is underlain by the same measures, more deeply buried, that are so productive in Indian Territory and Kansas.

PRODUCTION IN INDIAN AND OKLAHOMA TERRITORIES.

The following table shows the production of petroleum in Indian and Oklahoma Territories from 1891 to 1903, inclusive:

Production of petroleum in Indian and Oklahoma Territories, 1891–1903.

Year.	Quantity.	Year.	Quantity.
	Barrels.		*Barrels.*
1891	30	1898	....
1892	80	1899	....
1893	10	1900	6,472
1894	130	1901	10,000
1895	37	1902	a 37,100
1896	170	1903	a 138,911
1897	625		

a Oklahoma included since 1901.

Production of petroleum in Indian and Oklahoma Territories in 1902 and 1903, by months.

[Barrels.]

Month.	1902.	1903.
January	983	7,146
February	703	5,697
March	1,009	4,147
April	583	7,084
May	2,501	4,287
June	1,764	8,250
July	1,266	16,113
August	2,457	10,491
September	4,444	8,881
October	5,738	14,326
November	7,043	24,720
December	8,614	27,869
Total	37,100	138,911

Quantity of crude petroleum produced and shipped from Cherokee and Osage nations, Indian Territory, in 1903, by months and districts.

[Barrels of 42 gallons.]

Month.	Bartlesville.	Redfork.	Chelsea.	Total.
January	7,146	....	....	7,146
February	5,697	....	....	5,697
March	4,127	....	....	4,127
April	7,034	....	....	7,034
May	4,159	118	....	4,277
June	8,240	....	....	8,240
July	15,864	239	....	16,103
August	10,491	....	....	10,491
September	8,547	274	....	8,821
October	14,177	139	....	14,316
November	24,583	137	....	24,720
December	24,457	770	2,602	27,829
Total	134,522	1,677	2,602	138,801

Nine companies, with a total of 90 wells, were shipping crude oil to Kansas at the close of 1903.

A small well of high-grade petroleum was struck at Newkirk, Kay County, Okla., but has not been put to pumping. The following is an analysis of the petroleum, made by Prof. Edwin De Barr, of Oklahoma University:

Analysis of crude oil from well No. 1 of the Newkirk Gas and Mineral Company.

	Per cent.
Light gasoline oil	1.5
Middle gasoline oil	1.6
Heavy gasoline oil	6
Total gasoline oils (boiling below 170°)	9.1
Light kerosene or coal oil	6.5
Middle kerosene or coal oil	17.875
Heavy kerosene or coal oil	19.375
Total coal oil (boiling below 315°)	43.75
Light lubricating oil	5.75
Heavy lubricating oil	31.25
Total lubricating oil	37
Solid oils	2.5
Residue	7.65
Total	100

Flashes in open tester, 65° F.
Burns at 89° F.
Specific gravity, 0.851 = 34½° Baumé.

From this analysis it appears that the Newkirk petroleum is a mixed oil, consisting of both paraffin and asphalt bases; that the solid oil obtained by analysis is paraffin, and that the residue is mainly coke, and is useless as oil.

LOUISIANA.

The petroleum thus far produced in this State has been from wells in beds of loose sand saturated with petroleum. More or less difficulty has attended their successful operation. The developments at Jennings and Welsh have long ago passed the experimental stage, and have become regularly productive areas. Jennings is located 90 miles east of Beaumont, Tex., and 190 miles west of New Orleans. Welsh is some 12 miles west of Jennings.

The first well was opened in August, 1901, and tapped a loose bed of sand at 1,822 feet, which flowed spasmodically large quantities of sand and petroleum, accompanied with some natural gas. During the past year a number of producing wells have been added in both of these fields, accompanied by a number of dry holes. Some petroleum has also been developed in a well at Brearex Bridge. The serious difficulty in most of the wells is to control the loose sand saturated with petroleum, which is often forced into the casing by gas pressure and shuts off the flow. No solid material is encountered in drilling. The formation consists of a series of clay, sand, and "gumbo."

There was an increase in the production during the year 1903 of 369,145 barrels, or 67.29 per cent as compared with 1902. The petroleum produced at Jennings is slightly lighter in gravity than that produced at Beaumont and carries less sulphur. It finds a market chiefly for fuel purposes, its value being about 19,840 B. T. U. More or less petroleum and natural gas have been developed at Calcasieu, Lake Charles, Cowley, Lafayette, and Sulphur.

Production of petroleum in Louisiana in 1902 and 1903, by months.

[Barrels.]

Month.	1902.	1903.
January	....	46,560
February	....	65,108
March	....	82,900
April	....	83,725
May	25,000	75,279
June	60,000	97,137
July	75,000	96,478
August	92,894	78,017
September	68,728	67,945
October	81,257	66,690
November	70,707	68,904
December	75,086	95,605
Total	548,617	a917,771

a One company's production averaged.

Production and value of petroleum in Louisiana, by fields and years.

Year.	Jennings.		Welsh.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*		*Barrels.*	
1902	548,617	$188,985	....	....	548,617	$188,985
1903	892,609	391,066	25,162	$25,162	917,771	416,228
Total	1,441,226	580,051	25,162	25,162	1,466,388	605,213

TEXAS.

The close of the year 1903 about completes the third year of the discovery of the remarkable deposit of petroleum at Spindle Top by the large flowing well drilled by Captain Lucas. Since then within a radius of 30 miles from Spindle Top there has been produced, including loss by fire and fuel consumption, not less than 40,000,000 barrels of crude petroleum. A large quantity has also been absorbed by earthen reservoirs.

Since 1896 there has been a considerable production of a remarkably pure crude petroleum at Corsicana, amounting to 401,817 barrels in 1903, but the wells are small, and there has been a gradual decline since its maximum of 829,560 barrels of production was reached in 1900. The oil has been refined at that locality.

The rapid development of the Sour Lake pool, the increased production at Saratoga, the decline in the production of the original pool at Spindle Top, and the opening of an entirely new pool, known as Batsons Prairie, near the close of 1903 are among the important events in the industry of this State during the last year.

The chief market for the crude petroluem produced in this portion of the State is its use as fuel. The greater portion was transported by water from Port Arthur and Sabine Pass, and another very considerable portion was distributed by railways in tank cars to points of consumption. A considerable quantity of refined products and residuum was also shipped to coastwise and foreign ports. The entire production of the State in 1903 was 17,955,572 barrels, a decline of only 128,086 barrels as compared with that of 1902. On the other hand, the value of the production in 1903 was $7,517,479 as compared with $3,998,097 in 1902, a gain of $3,519,382. In 1903 Texas ranked third in quantity of production, being credited with 17.87 per cent of the total, and fifth in value, being credited with 7.93 per cent of the total value of the domestic output.

The actual quantity of all the petroleum brought to the surface in the Spindle Top, Sour Lake, Saratoga, and Batsons Prairie pools in 1903 is estimated to be close to 19,000,000 barrels. If to this, 500,000 barrels produced in Corsicana be added, the grand total for Texas production in 1903 is 19,500,000 barrels in round numbers, made up as follows:

	Barrels.
Shipped by water	8,000,339
Shipped by rail	6,096,207
Shipped to storage tanks	3,352,518
Estimated loss by fire and seepage, and used for fuel	1,550,936
Total production at Spindle Top, Sour Lake, Saratoga, and Batson	19,000,000
Production at Corsicana and Powell	500,000
Total production in Texas in 1903	19,500,000

EQUIPMENT AND DEVELOPMENT IN SOUTHEASTERN TEXAS.

There are at present completed and in operation in the southeastern Texas oil fields, not including Corsicana, 209 miles of 6-inch pipe line, 23 miles of 8-inch line, and 20 miles of 4-inch line—a total of 252 miles, exclusive of loops and connections, short lines to Beaumont from Spindle Top, and lines from the fields to the loading racks on the railroad lines. Adding these several connections, there is a grand total of over 300 miles, representing an investment of approximately $2,000,000.

At the close of the year there were in the southeastern Texas fields, not including Corsicana, 19,226,800 barrels of tankage. This was divided as follows: Steel tankage, 5,568,000 barrels; wooden tankage, 736,800 barrels; earthen tankage, 12,922,000 barrels. At the same time, by conservative estimate, there were distributed over the State, for the purpose of storing oil for the use of railroads, factories, etc., something over 2,000,000 barrels in steel and wooden tankage. In addition to this storage equipment, there were in operation on the railroads of Texas during the year over 1,500 tank cars, varying in capacity from the 300-barrel car of the Southern Pacific system to the 150-barrel and 160-barrel car of the private lines and distributing agents. These cars carried during the year about one-third of the total production of the fields to points in this State and Louisiana. Very little oil was shipped by rail elsewhere than to these two States. A considerable part of the oil so shipped was for the use of the railroad companies themselves as fuel for oil-burning locomotives, one company having since 1901 equipped 212 locomotives with oil burners and tank tenders.

Since the discovery of the Spindle Top field there have been drilled in that and other fields in Texas over 1,200 wells. This does not include the many unproductive wells drilled outside the limits of the proven fields and in other parts of the State in search of new fields. Of the total number of wells drilled in these fields a number not exceeding 300 were in operation at the end of the year. The remaining

900 and more were inoperative from three principal causes: 1. Many were lost in the early development period through faulty drilling. 2. Many which at first were good producers eventually ceased to produce and were abandoned. 3. Many others had to be abandoned on account of salt water which made its appearance either during the drilling operations or after a few weeks of good oil production.

SPINDLE TOP POOL.

PROMINENT EVENTS DURING 1903.

The original Spindle Top or Beaumont pool produced only one-half the quantity of petroleum in 1903 that it did in 1902. A very large portion of this quantity was secured by the slow method of pumping. During May an extension of the original lenticular pool containing less than 200 acres was secured to the northwest, a distance of about 1,000 feet, by the finding of a well which at first produced 5,000 barrels per day. However, this extension must have been very narrow, as only a few wells drilled in this new outlet proved of any value whatever, and the first well soon became choked with loose sand and was abandoned. In January of 1903 the entire production of this field was only about 25,000 barrels per day; during February it was increased to about 40,000 barrels per day from 110 wells in operation; but from this production there was a gradual decline, and at the close of the year the quantity was reduced to about 13,000 barrels per day. There was a number of wells drilled during the year into the first or upper pay, found at from 750 to 800 feet, which secured a moderate production. The larger quantity produced in this field comes from an open, porous limestone at a depth of about 1,050 feet. The upper pay is a loosely cemented sand from which in some instances shallow wells produced from 500 to 600 barrels per day. Many of the small operators became discouraged, sold out or leased their wells to the larger companies, and removed to Sour Lake and Batson Prairie, and there took part in the development of these newer fields. The slow and more economical exhaustion of what remains is being carried on by the purchasers.

The majority of the productive wells during 1903 were those more recently completed. The most productive area is that portion of the field known as the "Flats," just west of the original development. The presence of water in considerable quantity has seriously retarded production in many wells. The original well, which was drilled into the sand early in 1901 by Captain Lucas and which flowed at the rate of 70,000 barrels per day for ten days until capped, has long since ceased to be a producer.

On the 15th day of April, 1903, a serious fire broke out in this field, which destroyed a number of derricks, tanks, and equipments, and also consumed several hundred thousand barrels of petroleum, involving a loss of about $440,000 to the operators. The damage was soon repaired, and operations continued. According to all the most reliable sources of information that were available, the production of the Beaumont or Spindle Top pool during 1903 was 8,600,905 barrels, as compared with 17,420,949 barrels in 1902. Besides the several immense loading racks where the petroleum is loaded into tank cars connected to the wells by pipe lines, there are two 6-inch lines connecting Spindle Top with Port Arthur, operated by the Guffey Petroleum Company, one 6-inch line operated by the National Oil and Pipe Line Company, and another 6-inch line operated by the Texas Company; there is also one 6-inch line connecting Spindle Top with Sabine Pass, operated by the Lone Star and Crescent Company, and another 6-inch line operated by the Security Oil Company.

SOUR LAKE.

This field was partly developed during 1902, and is located in Hardin County, 25 miles northwest of Spindle Top. During 1903 the area of productive territory was shown to be about 250 acres, and up to the close of 1903 about 450 wells had been completed, of which only 150 were productive. In their early life a number of these wells produced over 20,000 barrels per day. During the first two months of the year only 6 or 7 wells were producing less than 1,000 barrels per day. Some of the original gushers opened during 1902 were abandoned early in 1903.

In May the real development of the Sour Lake pool began, and by the close of June 144 wells had been completed since the first of the year, the number of producing wells being 28. An area extending 3,800 feet north and south and 2,500 feet east and west had been proven to be profitable territory. On August 1 there were 75 producing wells; many others had been lost in drilling or abandoned as dry holes. The production at this time was estimated to be close to 80,000 barrels per day, which was far beyond the facilities for storing and transporting the output.

By the close of 1903 there were four 6-inch lines and one 8-inch line leading to Beaumont, a number of lines leading to the loading racks at the railroad, one 6-inch line to Saratoga, 10 miles distant, and one 4-inch line to Raywood station, on the Southern Pacific Railroad.

The greatest production in this field was in August and September, when it averaged from 50,000 to 60,000 barrels per day, while that for December was between 18,000 and 20,000 barrels per day, the decline being due to the falling off of the known areas of production. On what is known as the "Shoestring tract," so called on account of the land being divided up into long narrow strips, many wells were drilled within a few feet of each other until 150 had been completed.

Many of these wells were originally good producers; but the closeness of the holes soon depleted the reservoir, which caused the abandonment of one-half, and left but 75 productive wells at the close of the year. In the southeastern portion of the field on the Davis tract over 100 wells were drilled during the year, not half of which were productive.

The early development of the Sour Lake field dates back to 1893, when 6 or 7 wells were drilled to a depth of from 260 to 370 feet. Three of these wells produced a limited quantity of very dark and heavy petroleum of about 16° Baumé. There was also some natural residuum found on the surface near where these first wells were drilled. A second sand is found at an average depth of 750 feet. Some of the wells on this horizon produced as much as 1,000 barrels per day. The third and fourth sands or pays are encountered at from 850 to 1,050 feet, respectively. The last-named horizons were by far the most productive, and many of them produced as much as from 10,000 to 20,000 barrels per day when first opened up. One remarkable condition was developed especially in this field—the sand being found to be quite uniform in depth but often locally irregular inside of short distances. In a number of instances, where wells were only a few feet apart, one well found a prolific pay streak, but the other failed to find any, although drilled many feet below the depth of the paying well.

The production of this district in 1903 is placed at about 8,700,000 barrels, which is slightly more than the production at Spindle Top for the same time. The quality of the petroleum is quite similar to that produced at the latter plaee, but it is slightly heavier in specific gravity.

The prices fluctuated considerably in 1903, the highest quotation being 60 cents per barrel in May, the lowest being 15 cents in August, and the average for the year being 30½ cents per barrel.

There was little regularity in the production of wells in close proximity; a few made notable records by their temporarily large output. The Sharp well produced 325,000 barrels in twenty days, valued at $80,000. Gilbert No. 1 produced enough petroleum in thirty days to bring $125,000. These were exceptional wells, however, and at the close of the year there were no flowing wells, all the production being secured by pumping.

Considerable difficulty was experienced in the winter months in freeing the heavy petroleum produced from water, as the pipe lines insist that only a small percentage of the latter must be delivered to them. To get rid of the water it was necessary to heat the petroleum in settling tanks. This was expensive and caused delay in transportation. The tankage in the Sour Lake district at the close of 1903 amounted to 3,155,000 barrels, distributed as follows: Iron tankage, 1,555,000 barrels; wooden tankage, 200,000 barrels; earthern tankage, 1,400,000 barrels.

The most disastrous fire of the year in this field broke out on August 24, and destroyed several derricks and a large amount of equipment. However, only about 1,500 barrels of oil were consumed. A very serious effect of the fire was that, when the wells were repaired, they refused to flow upon being reopened, and many of them were abandoned.

SARATOGA DISTRICT.

This pool is located 10 miles northwest of Sour Lake and 35 miles from Spindle Top. The area so far developed contains about 150 acres, upon which there are 5 wells pumping 2,225 barrels per day. The production for this year is estimated to be about 150,000 barrels, gravity 18° Baumé.

Operations in this field began a number of years ago, when a spring-pole rig drilled to the depth of 100 feet and found a heavy black petroleum accompanied with some natural gas. Some years afterwards a shallow well drilled to the depth of 250 feet produced considerable petroleum. Not until after the remarkable development at Spindle Top were deeper wells drilled which resulted in developing a pool. Hooks well No. 1 was drilled to 1,000 feet, when it flowed naturally and produced at first about 500 barrels per day. On May 1 Tell well No. 1 was drilled in and flowed at the rate of 500 barrels per day. In June there were fourteen locations. In July the Rio Bravo Oil Company (Southern Pacific Railroad Company) drilled in a well near Hooks well No. 1, which started off at 500 barrels per day. During the year three iron tanks, having a capacity of 130,000 barrels were completed, also wooden tankage to hold 4,000 barrels was completed.

Several large pockets of gas were encountered at a depth of 500 feet by a number of the wells, which for a time blew out in considerable quantity, accompanied by more or less sand and mud.

BATSON PRAIRIE DISTRICT.

On the last day of October, 1903, a flowing well was drilled in at the third entirely new field in southeastern Texas, Batson Prairie, Hardin County, 8 miles west of Saratoga and 15 miles west of Sour Lake. Previous to this discovery a well was drilled in this locality by the Libby Oil Company, in the fall of 1901, which, at a depth of about 1,000 feet, encountered a small showing of petroleum followed by a large flow of hot salt water, when the well was abandoned without further test. This well is about 3 miles from that of the Paraffin Oil Company, which at 790 feet in depth found a big flow of petroleum. Drilling was continued through about 35 feet of oil strata, and the flow was natural.

The petroleum found in this field is different in character and gravity from that of Sour Lake and Spindle Top, having a gravity of between 23½° and 24° Baumé. Just after the close of 1903, the Riley well, south of the Paraffin Companies' well, found oil at a depth of about 1,150 feet, which flowed at the rate of 18,000 barrels per day. Previous to this a second well on the Paraffin Oil Company's property on the 19th day of December had a blow-out of mud and sand which filled up the casing. After cleansing the hole of mud and water, a solid stream of petroleum began to flow to the top of the derrick, which was controlled with difficulty. When opened, this well produced 4,500 barrels per day. The petroleum produced by this well has a gravity of 29.9° Baumé, the highest of any petroleum produced in southeastern Texas. On December 24, well No. 3 of the Paraffin Oil Company pierced the oil pay, which, like that found on Spindle Top, developed some salt water. When this was bailed off, it started to flow at the rate of 15,000 barrels per day. By the close of the year 28 rigs had been built, and operations were increasing daily. Only 4,500 barrels are reported as sold in this district during 1903, at 25 cents per barrel.

The other districts and localities in Texas producing more or less petroleum, as well as the physical and chemical character of the petroleum produced in the State are fully discussed in the report for 1902, and, as the conditions are practically unchanged, the discussion is not repeated.

CORSICANA DISTRICT.

This pool is located at Corsicana, Navarro County, 200 miles northwest of Beaumont. Since 1897 it has had an average annual production of over 500,000 barrels of a superior crude petroleum very different from that found elsewhere in the State.

The output has decreased about 47 per cent since 1901, 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 quantity.

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, 2 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, are now producing only from 3 to 8 barrels per day.

The production in 1903 showed a considerable decline in the production of the lighter grade and a considerable increase in the heavier grade produced near Powell Station.

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.

PRODUCTION OF PETROLEUM IN TEXAS.

The production of petroleum in Texas since 1889 has been as follows:

Production of petroleum in Texas, 1889–1903.

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	1903	17,955,572
1896	1,450		

Production of crude petroleum in Texas, 1875–1903, by districts.

Year.	Corsicana.	Powell.	Beaumont.	Saratoga and Sour Lake.	Batson.	Total.
1895						50
1896	a1,450					1,450
1897	a65,975					65,975
1898	544,620					b546,070
1899	668,483					b669,013
1900	829,560	a6,479				836,039
1901	763,424	a37,121	3,593,113			4,393,658
1902	571,059	46,812	17,420,949	a44,838		18,083,658
1903	401,817	100,143	8,600,905	8,848,159	4,518	a17,955,572

a Includes a small quantity produced elsewhere in the State.
b Includes a small quantity produced outside of Corsicana field.

CALIFORNIA.

The most important event connected with the output of petroleum in the United States in 1903 was the remarkable increase in the production of California and its sudden elevation to head of the States producing petroleum, superseding Ohio, which for several years previous ranked first. When values are compared, however, California's rank is sixth, being slightly less than that of Texas. During 1903 the State produced 24.27 per cent of the production and 7.81 per cent of the value of the petroleum produced in the United States. The total State production was 24,382,472 barrels in 1903, an increase of 10,398,204 barrels, or 74.36 per cent over that of 1902. The value of the petroleum produced was $7,399,439, an average of 30.3 cents per barrel, as compared with 34.8 cents per barrel in 1902.

The greater portion of the increase in 1903 came from Kern County, which, almost doubling its former large output, produced over 74 per cent of the total. The largest percentage of gain was in Fresno County, which increased 374 per cent over the production of 1902. The average price paid for the petroleum produced in Kern County in 1903 was 21 cents per barrel, and 33 cents for that produced in Fresno County. The highest price paid was for a limited production from Santa Clara County, valued at $1.91½ per barrel.

FIELD OPERATIONS.

There was a total of about 480 wells completed during 1903, of which number about 125 were dry holes. Of the 16 counties in this State in which wells were drilled by far the greatest number were drilled in Kern County. So far profitable developments have been confined almost entirely to the Coast range, on the western side, and to the southern end of the great central San Joaquin Valley.

Operations were conducted in the counties of Kern, Fresno, Los Angeles, Orange, Ventura, Santa Barbara, Santa Clara, San Mateo, Monterey, Kings, Madera, Contra Costa, Colusa, San Bernardino, and Humboldt counties. No new pools were opened, most of the operations for the year being confined to known localities as the increased facilities of transportation enabled much new work to be prosecuted.

KERN COUNTY.

The Bakersfield, McKittrick, and Sunset fields, located in this county, were the scene of much active work during 1903, which resulted in the production of 18,077,900 barrels. The loose sand in which the deposit is found in this field is remarkably regular and often of great thickness, and the wells are also remarkably regular in their output, and range from 900 to 1,000 feet in depth. There must be considerable gas pressure to cause so heavy an oil as is found to flow naturally. The Bakersfield pool is by far the most important, and there is good reason to infer that this pool will continue to produce still greater quantities of this quality of petroleum in the future. The southern terminus of the pipe line leading to Port Richmond is located at this field, and there is an immense quantity of petroleum, amounting to 3,500,000 barrels, stored in iron tanks in this vicinity.

FRESNO COUNTY.

The production in this county, so far, comes from what is known as the Coalinga field, in the southern portion of the county. Recently there was an extension of the field to the southwest. There was a remarkable increase in the production secured in this pool during 1903, which amounted to 1,560,129 barrels, or 374 per cent over that of 1902.

There are a number of grades of petroleum produced in this field, which range from 11° to 45° Baumé. The greater portion has a gravity of about 33° Baumé, but strange as it may seem the lighter grades are nearest the surface. Since 1897 this field has had from 5 to 7 miles of pipe line in operation to receiving tanks on the Southern Pacific Railway, near Coalinga. The Pacific Coast Oil Company has connected the Coalinga field with Mendota Station by 31 miles of pipe line. This station is on the main line from Bakersfield to Point Richmond, and 166 miles south of the last-named locality. One of the serious draw-backs at Coalinga is the scarcity of water, which is supplied to the drilling and pumping wells by a pipe line from wells several miles distant.

LOS ANGELES COUNTY.

The Los Angeles pool was quite active during 1903, and increased its production by the careful working of the original wells from 1,938,114 barrels in 1902 to 2,087,627 barrels in 1903. There was an average of 1,150 producing wells pumped during the year. Nearly the entire production was marketed as fuel petroleum. The Whittier pool in the southeastern portion of this county reaches over into Orange County, and is known as the Fullerton pool. There are a number of deep wells in this pool that produce a large quantity of superior petroleum susceptible of refining in a profitable way. Other wells toward Brea Canyon produce large quantities of dark and heavy fuel petroleum.

At Newhall nothing new was developed during 1903. The older wells have been operated regularly and a few new producers added inside of the developed territory. In this pool a very light variety of petroleum was found several years previous which was almost colorless and had a specific gravity of 50° Baumé.

SANTA BARBARA COUNTY.

In Santa Barbara County the Union and the Pinal Oil companies each secured a large flowing well during 1903, with indications of the existence of a large petroleum deposit at both localities.

Ventura and San Mateo counties had some slight fluctuations in their production. There is a slight production for the first time recorded for Santa Clara County.

TRANSPORTATION.

One of the most important events of the year bearing upon the petroleum industry in California was the successful operating of the pipe line built by the Pacific Coast Oil Company and extending from Bakersfield to Point Richmond, a distance of 278 miles, with a branch line of 31 miles from Mendota to Coalinga.

The successful handling of petroleum produced in Kern County, the southern terminal, with a gravity averaging 15½° Baumé, was an entirely new departure in the transporting of liquids in pipes. This was brought about principally by the heating of the fluid by the exhaust steam and the covering of the line with a nonconductor; it was assisted also somewhat by the admixture of the lighter crudes developed at Coalinga, and in some instances by using a percentage of water.

The pipe line is now delivering from 20,000 to 25,000 barrels per day.

REFINERIES.

There are about 40 refineries in California, although many of them can hardly be classed as such, as they are designed more particularly to reduce the asphalt to a more compact form suitable for roadways. This is done by crudely distilling the heavier natural petroleum, from which 35 to 45 per cent of solid asphalt is secured. By far the most important refinery in the State was in process of erection during 1903 at Point Richmond, on the waters of San Francisco Bay, connected by rail with the Santa Fe Railroad. This refinery is one of the largest, and is destined to have a most important influence by refining the crude petroleum of California for distribution on the Pacific coast, and to the Hawaiian Islands, Japan, China, and India by tank steamers as a grade of petroleum that can be sold at reduced rates to the great masses of humanity who inhabit those portions of the globe. A large proportion of California petroleum must continue to be disposed of as fuel.

PETROLEUM FUEL.

The successful introduction of petroleum fuel on the Pacific coast has caused the rapid decline in the importation of coal. The problem of cheap fuel has been solved. The railroads, the manufacturers, and the steamship lines are being directly benefited by its general introduction as an economical and perfect fuel.

Petroleum that is to be consumed inside of buildings or in steam vessels should not contain any of the lighter products, which are in many cases found even in the heavier crude. It should have a fire test ranging from 220° to 270° F. Under these conditions it is safe to handle and there is no loss from evaporation.

Numerous tests have shown that where the petroleum fuel is sold by measure the heavier grades have as high an evaporative test as the lighter ones; when sold by weight the lighter crudes usually have a higher evaporative value.

The important condition necessary is good combustion, and to insure that the liquid fuel should be completely atomized by a steam jet or by compressed air. The latter is preferable, especially when superheated, because it more easily produces complete combustion and does not carry off so large a quantity of heat. To insure satisfactory results it is also necessary in all cases to have the jet of liquid fuel spray upon hot fire bricks and not come in direct contact with the plates of the boiler until the combustion has been completed.

The best results have been secured by building an arch of fire brick over the grate bars, the crown of which comes within 5 or 6 inches of the bottom of the boiler and is parallel to it. About every fourth brick in this arch should be left out for openings through which the products of combustion may escape. Inside of this arch a loose checkerwork of fire brick should be placed, upon which the petroleum should spray, only the necessary air being admitted through the openings of the grate bars. This can easily be regulated by the arrangement of the fire brick upon the bars.

In like manner the fire boxes of locomotives which use petroleum for fuel must be arched with fire brick above where the spray strikes the back of the box, which must also be protected by fire brick, and an inverted arch of the same material should extend down into the ash pan, with open spaces in the brickwork and an open space at the front end for the admission of the air.

The following table gives the number of barrels of petroleum equivalent to 1 ton of the coal usually found in the San Francisco markets, the cost of petroleum being estimated at $1 per barrel. If the cost is more or less than $1 per barrel the figures in the third and fourth columns can be changed proportionally. The third column gives the price that the purchaser can afford to pay for coal per ton to equal the fuel value of petroleum at $1 per barrel. The fourth column shows the reduction in cost of the fuel, due to the cheaper handling of petroleum.

Table showing the number of barrels of petroleum equivalent to 1 ton of the various coals, and the value of different coals per ton, as compared with petroleum at $1 per barrel.

One pound of combustible.	Pounds of water evaporated at 212° F. per pound of combustible.	Barrels of petroleum required to do the same amount of evaporation as 1 ton of coal.	Cost of coal per ton to equal petroleum at $1 per barrel.	Less 10 per cent, owing to the greater economy in handling petroleum.
Petroleum, 15° to 18° Baumé	16.0	....	....	....
Cardiff lump, Wales	10.0	4.0	$4.00	$3.60
Cape Breton, Canada	9.2	3.7	3.70	3.33
Nanaimo, British Columbia	7.3	2.9	2.90	2.61
Cooperative, British Columbia	8.9	3.6	3.60	3.24
Greta, Washington	7.6	3.0	3.00	2.70
Carbon Hill, Washington	7.6	3.0	3.00	2.70

PRODUCTION OF PETROLEUM IN CALIFORNIA.

In the following tables is shown the production of petroleum in California by years, by counties for 1903, and by counties for various years:

Production of petroleum in California, 1876–1903.

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	1903	24,382,472
1889	303,220		

Production of crude petroleum in California in 1902 and 1903, by counties.

County.	1902.			1903.		
	Quantity.	Total value.	Value per barrel.	Quantity.	Total value.	Value per barrel.
	Barrels.			*Barrels.*		
Fresno	572,498	$257,629	$0.45	2,138,058	$705,559	$0.33
Kern	9,705,703	2,397,372	.247	18,077,900	3,796,359	.21
Los Angeles	1,938,114	1,119,679	.58	2,087,627	1,303,406	.624
Orange	1,038,549	661,158	.636	1,418,782	1,097,290	.776
Santa Barbara	242,840	167,911	.69	306,066	159,883	.522
Ventura	484,764	267,168	.55	348,295	322,342	.926
San Mateo	1,800	2,700	1.50	5,137	9,837	1.915
Santa Clara	....	....	....	5,607	4,723	.842
Total	13,984,268	4,873,617	.348	24,382,472	7,399,349	.303

Production of crude petroleum in California, 1897–1903, by counties.

[Barrels of 42 gallons.]

Year.	Fresno.	Kern.	Los Angeles.	Orange.	Santa Barbara.	Ventura.	Santa Clara.	San Mateo.	Total.
1897	70,140	....	1,327,011	12,000	130,136	368,282	4,000	....	1,911,569
1898	154,000	10,000	1,462,871	60,000	132,217	427,000	3,000	....	2,249,088
1899	439,372	15,000	1,409,356	108,077	208,370	496,200	1,500	....	2,677,875
1900	582,000	892,500	1,730,263	372,200	153,750	418,000	771	....	a 4,324,484
1901	780,650	4,493,455	2,188,633	724,565	135,900	463,127	....	....	8,786,330
1902	572,498	9,705,703	1,938,114	1,038,549	242,840	484,764	....	1,800	13,984,268
1903	2,138,058	18,077,900	2,087,627	1,413,782	306,066	348,295	5,607	5,137	24,382,472

a Includes 225,000 barrels unapportioned.

Production and value of crude petroleum in California in 1901, 1902, and 1903, by counties.

[Barrels of 42 gallons.]

County.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Fresno	780,650	$390,325	572,498	$251,388	2,138,058	$705,559
Kern	4,493,455	1,704,085	9,705,703	2,397,372	18,077,900	3,796,359
Los Angeles	2,188,633	1,584,412	1,938,114	1,119,679	2,087,627	1,308,406
Orange	724,565	724,565	1,038,549	661,158	1,413,782	1,097,280
Santa Barbara	135,900	116,640	242,840	167,911	306,066	159,833
Santa Clara	....	....	....	....	5,607	4,723
Ventura	463,127	454,513	484,764	267,168	348,295	322,342
San Mateo	....	....	1,800	2,700	5,137	9,837
Total	8,786,330	4,974,540	13,984,268	4,873,617	24,382,472	7,399,349
Value per barrel	....	0.566+	....	0.348	....	0.303

CONDITIONS OF PRODUCTIVE DISTRICTS IN 1903.

The following table, compiled by Mr. Paul W. Prutzman, of the State mining bureau of California, shows the conditions of the productive districts in 1903:

Conditions of petroleum-producing districts of California in 1903.

District.	County.	Nature of surface.	Geological age.
Sargent	Santa Cruz	Rolling grassy hills	Tertiary.
Coalinga Oil City	Fresno	Rough rocky hills	Upper Cretaceous.
"28"	....do	Rolling barren hills	Middle Neocene.
Southwest	....do	Low barren hills	Do.
Kern River	Kern	....do	Do.
Sunset	....do	....do	Lower and Middle Neocene.
Midway	....do	Rolling barren hills	Middle Neocene.
McKittrick	....do	....do	Do.
Carreaga	Santa Barbara	Rolling grassy hills	
Summerland	....do	Ocean beach	Middle Neocene.
Newhall	Los Angeles	Rough rocky hills	Lower and Middle Neocene.
Los Angeles	....do	City lots	Lower Neocene.
Whittier	....do	Rolling hills	Middle Neocene.
Puente	....do	....do	Do.
Ventura	Ventura	Rough rocky hills	Eocene and Lower Neocene.
Fullerton	Orange	Rolling hills	Middle Neocene.

Conditions of petroleum-producing districts of California in 1903—Continued.

District.	Formation.	Depth of wells.			Number of wells.			Estimated production per day.		
		Maximum.	Minimum.	Average.	Producing.	Dry.	Drilling.	Maximum.	Minimum.	Average.
		Feet.	*Feet.*	*Feet.*				*Bbls.*	*Bbls.*	*Bbls.*
Sargent	Shale and sandstone	1,000	600	....	2	11	3	....	....	25
Coalinga Oil City.	Hard shale and sandstone.	2,260	540	1,500	17	31	0	....	....	125
"28"	Shale and dry sand	1,800	450	1,050	49	12	7	2,500	10	150
Southwest	Shale and quicksand	1,800	550	850	35	20	18	400	10	100
Kern River	Clay and sand	1,200	650	1,000	592	91	....	250	50	75
Sunset	Shale and sand	1,100	550	900	103	41	....	250	5	50
Midway	.....do	1,500	780	1,100	42	15	4	....	....	....
McKittrick	Shale and quicksand	2,000	400	900	91	86	8	1,500	10	45
Carreaga	....	2,400	....	2,000	18	4	5	2,500	25	50
Summerland	Clay and sand	600	150	250	228	171	2	60	1	5
Newhall	Sandstone, shale, conglomerate and crystalline rocks.	1,950	400	....	51	39	3	50	5	10
Los Angeles	Clay and sand	1,300	300	600	1,042	537	12	20	1	3
Whittier	Clay, sand, and shale.	2,200	285	1,250	76	2	12	....	3	32
Puente	Shale	2,000	1,000	....	45	....	3	40	5	8
Ventura	Sandstone, shale, and conglomerate.	2,100	90	1,000	319	103	23	60	2	5
Fullerton	Shale and sandstone	1,875	400	1,100	98	22	29	3,000	6	32

PHYSICAL PROPERTIES OF CALIFORNIA PETROLEUM.

The following table, giving maximum, mimimum, and average gravities, Beaumé, for a number of districts, was also compiled by Mr. Paul W. Prutzman, of the State mining bureau of California. The figures marked † were copied from various sources. The viscosity was determined by the Engler instrument; water at 15.5° C—1.

Physical properties of crude petroleum from producing districts in California.

District.	Color.	Gravity ° B.			Viscosity.			Flash point.		
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
								° *F.*	° *F.*	° *F.*
Coalinga Oil City	Green	34	32.5	33.3	....	....	1	....	....	80
"28"	Dark brown	28	18.3	22	40	2	30	160	80	150
Southwest	Black	17.8	11.5	16	2,500	60	200	325	160	250
Kern River	.....do	17	12	15.5	1,500	250	....	350	200	275
Sunset	.....do	17	10	14	2,000	275	....	350	200	275
Midway	Black-brown	14	20.2	....	1,500	27	....	300	160	....
McKittrick	Black	20	12	17	2,000	25	250	300	180	200
Carreaga	.....do	....	....	17	....	....	160	....	....	130
Summerland	Brown	16.5	13	14.5	1,000	300	600	250	200	225
Ventura City	.....do	†35	†10.5	24	1,500	2	30	....	60	....
Newhall	Black-white	42.7	†25	....	....	1	....	....	60	....
Los Angeles	Black	†18	11	13.5	....	....	1,500	....	....	260
Whittier	.....do	26	13	19	†1,800	10	35	....	....	110
Puente	Brown	†35	†22	....	....	....	....	....	....	....
Fullerton	.....do	†30	†18	21	....	....	....	....	....	....

PROXIMATE ANALYSES OF CALIFORNIA CRUDE PETROLEUM.

The following tables give the result of the distillation of a number of California crude petroleums from districts that are producing petroleum in profitable quantities and also of some petroleums from nonproducing districts where the quantity is not sufficient to be worked profitably.

Proximate analyses of California crude petroleum from producing districts.

District.	Classification.	Gravity. °B.	Distillation (per cent).				Asphaltene (per cent).	Maumene number.	Nitrogen.		Sulphur.	
			Below 150° C.	150°–270° C.	Above 270° C.	Asphalt, Grade D.			Oil.	N. (per cent).	Oil.	S. (per cent).
								°	°		°	
Coalinga Oil City	Intermediate.......	33.1	28	50	22	0	None	......	34	0.063	31	a0.082
Do	.....do	45	52	27	21	0	None	0.30	....	......	....	......
Twenty-eight........	Light asphaltic.....	22	6	26	53	15	2.04	.247	22	b.302	22	.817
Do	.....do	18.7	1	18	61	20	1.87	......	19	b.314	....	......
Southwest	Heavy asphaltic....	17.8	0	18	60	22	2.83	......	18	b.299	18	.874
Do	.....do	16.1	0	7	72	21	2.83	......	16	b.375	....	......
Kern River	.....do	15	0	11	54	35	3.06	.341	15	b.600	14	.612
Sunset	.....do	9.9	0	5	44	51	2.93	.432	10	b.370	10	1.253
Do	.....do	17.[illegible]	4	12	60	24	3.01	......	17	b.476	18	a.860
Midway..............	Light asphaltic.....	20.2	8	24	53	20	1.80	......	20	b.374	....	......
McKittrick	.....do	19	1	22	56	21	2.35	.347	19	b.800	18	.870
Do	Heavy asphaltic....	15	0	11	65	26	......	.365	(?)	c.290	14	.565
Carreaga...........	.....do	16.9	1	24	37	38	8.37	.482	17	b.430	....	......
Summerland.........	.....do	15	0	11	49	40	3.36	......	(?)	d.880	15	.886
Newhall	Intermediate.......	42.7	51	43	6	0	None	.050	....	......	....	......
Ventura	Light asphaltic.....	25.6	10	24	44	22	2.05	......	(?)	e.606	28	f1.500
Los Angeles..........	Heavy asphaltic....	13.5	0	10	59	31	3.99	......	(?)	g.648	14	1.062
Whittier	Light asphaltic.....	19	5	20	38	37	4.94	.335	19	a.669	19	a.700

a Edmund O'Neill, Jour. Am. Chem. Soc., July, 1903.
b Paul W. Prutzman.
c Mabery and Hudson, Am. Chem. Jour., 25–253.
d Mean of 4 samples, S. F. Peckham, Am. Jour. Sci., 48–250–255.
e Mabery and Hudson, Am. Chem. Jour., 25–253, mean of 13 samples.
f Mabery and Quayle, Jour. Soc. Chem. Ind., 19–502–508.
g Mabery and Hudson, Am. Chem. Jour., 25–253, mean of 4 samples.

Proximate analyses of California crude petroleum from nonproducing districts.[a]

District.	Classification.	Gravity. °B.	Distillation (per cent).				Asphaltene.	Maumene number.
			Below 150° C.	150°–270° C.	Above 270° C.	Asphalt, Grade D.		
Alcalde	Intermediate	24	1	33	60	6	Slight tr.	......
Fresno-San Benito.	Light asphaltic	24.7	8	31	45	16	1.40	......
Do	.....do	33	20	25	50	5	4.08	......
Do	.....do	23	11	31	36	22	.64	......
Bitterwater	Intermediate	42.7	28	37	35	[b] 0	.46	.068
Moodys Gulch	Paraffin	38	26	35	39	0	Slight tr.	......
Monterey County	.....do	26.8	0	2	98	0	Slight tr.	......
San Mateo County	.....do	41.5	39	46	15	0	None.	......
Do	.....do	48.8	48	33	19	0	None.	.065
Napa County	Doubtful	15.2	0	15	78	[b] 7	.49	.158
Colusa County	.....do	15.3	0	19	81	[b] 0	Slight tr.	.306
Bolinas Bay	Light asphaltic	21.5	2	24	52	22	6.23	.370
Humboldt County	Paraffin	41.5	28	42	30	0	None.	.030

[a] Analyses by Paul W. Prutzman.
[b] The 7 per cent residue from Napa County oil and the trace of residue from other oils thus marked is not asphalt, though closely resembling it.

HAWAIIAN ISLANDS.

These islands have for many years depended on the importation of Wellington coal from Australia and Nanaimo coal from British Columbia. It is necessary to transport the former 5,000 miles and the latter over 2,000 miles. The United States Government has for a number of years maintained a coaling station on these islands, which is supplied from San Francisco at a cost of from $9 to $10 per ton. The coal supplied to the sugar plantations and other manufacturers probably costs $2 to $3 more per ton. All the coal imported is of an inferior quality and contains a large percentage of sulphur, which causes it to deteriorate upon exposure. Probably between 3 and 3½ barrels of petroleum would equal the calorific value per ton of the best coal found in Hawaii. The development of a very large quantity of fuel petroleum in California made it possible to introduce this fuel at a cost of about 3 cents per gallon, or $1.35 per barrel, and as 3¼ barrels of petroleum is equal to 1 ton of coal, the cost would be about $4.39 for the quantity of petroleum necessary to equal 1 ton of coal. This reduces the cost of fuel more than 50 per cent, besides adding many other advantages resulting from the use of petroleum in a tropical country where the work of the stoker is especially onerous. It is highly probable that California petroleum will eventually become a great factor in the navigation of the Pacific by steamships belonging to the transportation companies and also by those of the United States Navy. The results of trials on numerous trading steamers on the Pacific coast have been so eminently satisfactory that it is only a question of the supply for general introduction.

The first table following shows that in 1902 there was no exportation of crude petroleum to the Hawaiian Islands, but that in 1903 there were received from San Francisco 244,132 barrels at a cost of about $1.35 per barrel. The second table reveals the rapidity with which this industry is increasing.

Shipment of crude and refined petroleum to Hawaii from the United States in fiscal years ending June 30, 1902 and 1903.

Kind of oil.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*	
Crude	....	....	10,258,552	$328,554
Naphtha	850	$130	269,235	34,877
Illuminating	1,217,780	188,109	900,225	130,281
Lubricating	138,058	39,571	109,285	43,973

Export of crude and refined petroleum to Hawaii from the United States in the six months ending, respectively, December 31, 1902 and 1903.

Kind of oil.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*	
Crude	2,610,964	$78,580	13,576,000	$453,600
Naphtha	189,694	23,695	183,141	22,230
Illuminating	445,195	62,861	916,540	127,433
Lubricating	43,429	16,696	65,589	22,957

ALASKA.

The developments in Alaska during 1903 have not resulted in any commercial production of petroleum, notwithstanding the numerous surface indications and the wells that have been completed in the supposed productive territory. The prospectors should not, however, be discouraged, although it may require patience and careful prospecting with the drill to tap the reservoirs, whose existence seems to be indicated by remarkable surface shows of both petroleum and natural gas.

There are four localities where there are more or less shows of petroleum, which have attracted the prospector. The first out from Sitka is located between Icy Cape and Cape Yaktag or Yakataga, just northwest of the great Malaspina glacier, 400 miles northwest of Sitka and a few miles back from and parallel with the coast line. This section is one that is most difficult to visit, owing to the very rough character of the shore and the absence of a harbor, and little is known of this field. It is reported that for a few miles many of the small streams flowing into the ocean carry a continuous scum of crude petroleum, that the structural conditions are comparatively regular, and that there are numerous springs and seeps of petroleum, but nothing in the way of drilling a test well has been accomplished.

Following the coast line almost 100 miles Cape Suckling is reached, where the eastern portion of what is known as the Kayak field is located. From this cape to the first delta of the Copper River is about 40 miles in a northwestern direction. From 1 to 10 miles back of the coast line in this region there are indications of petroleum in small pools. Natural gas is found on the shores of Controller Bay, and farther inland to the northeast there are numerous outcroppings of bituminous coal. Dr. G. C. Martin,[a] who visited this region during 1903, reports the petroleum-bearing shales to be made up of a series of dark argillaceous and carbonaceous shales, with an occasional band of sandstone, limestone, conglomerate, and glauconitic rock of probable Tertiary age. All the rocks are generally highly inclined, but there are localities where the slopes are comparatively gentle and the anticlinal structure well marked. The first well in this region was drilled by the Alaska Steam Coal and Petroleum Syndicate, who have subleased from the Alaska Development Company. The well was not drilled to any great depth before the tools were lost and work was suspended; some petroleum was, however, found in this well. The same company drilled a more successful well during the year 1902, which at a depth of 250 feet developed a showing of petroleum, and at a depth of 365 feet in sandstone opened up a considerable amount of petroleum. During the year 1903 this well was drilled to a depth of 500 feet without finding any large flow. About 4,000 feet south of this last well another company drilled a well to a depth of 1,700 feet, and failed to find petroleum in quantity, although the bailer bought up a small quantity. A well was drilled on one of the islands in the Chilkat River, 7 miles above its mouth, which at a depth of over 500 feet failed to find any petroleum. Another well was drilled on the bank of the Katalla River, about two miles above the village of Katalla, which also failed to find sufficient petroleum at the close of 1903.

The third field is known as the Cooks Inlet field. This field lies on the west shore of the main inlet, between Itimna Peak and Itimna Lake, near the mouth of Innerskin Bay, on whose shores there are numerous seepages of petroleum, a considerable quantity of petroleum being found at times on the surface of the water in the vicinity of Oil Bay. A well was started at Oil Bay during the summer of 1902, which at 500 feet was reported to have found some petroleum; when drilled deeper the well struck a large flow of salt water, which was followed by a flow of gas, and the well was finally abandoned. During 1903 a new well was started, but it has not produced much petroleum.

The fourth field where there has been a well drilled is known as the Cold Bay field, and is located near where the Alaska Peninsula leaves

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[a] Martin, G. C., Petroleum Fields of Alaska: Bull. U. S. Geol. Surv. No. 225, 1904, pp. 365–382.

the main land, being nearly opposite the southern extremity of Kadiak Island. The strata at this locality are said closely to resemble those of the Cooks Inlet field, and the strata can be followed for a considerable distance on their outcrop. There were two wells drilled in this field during 1903, but no practical results are reported from either of them. Mr. Martin says that on the hill slopes, several miles in the interior, there are seepages of petroleum, the continued discharge from which has run down the hillside and impregnated the bituminous matter in a swamp with paraffin wax and produced a fuel of considerable value, which was used under the boiler in drilling.

There has been a great rush of prospectors to this region, many of whom have staked out a large number of claims under the placer mining laws and placed them on the market; many of these are without purchasers and must in the course of time become forfeited.

FOREIGN COUNTRIES OF THE WESTERN CONTINENT.

CANADA.

ONTARIO.

The production of petroleum in Canada comes almost entirely from the Petrolia and Oil Springs districts, in Lamberton County, and Bothwell, in Kent County, Ontario. One of the first productive wells was put down at Oil Springs in 1862, which flowed vigorously. For nearly twenty-five years the quantity of petroleum produced in Canada has been gradually declining, notwithstanding the opening of a number of smaller pools within the last four years. One of the most important of the recently-developed pools is known as the Dutton district, in Elgin County. There was also some production in the southeastern portion of Essex County. At Brantford, in Brant County, two wells found petroleum in the underlying Medina sand near the close of 1903.

Nearly all of the crude petroleum produced in Canada comes from the Corniferous limestone, and contains a considerable proportion of sulphureted hydrogen, which imparts an unpleasant odor to the finished product, unless removed by special treatment.

The wells are usually from 330 to 400 feet in depth, and are cheaply drilled, as only one string of casing is required. Owing to these conditions, there is a great number of wells in operation compared with the production secured. The present production in Canada does not amount to more than 40 per cent of the quantity consumed, the deficiency being supplied by the United States.

The table on a subsequent page gives the annual production from 1898 to 1903, during which period there was a yearly decline of about 40,000 barrels.

In Quebec a number of deep wells have been drilled in the last ten years on Gaspé Peninsula. In all, 52 wells have been drilled in this locality, from 500 to 3,700 feet in depth. A number of these have shown traces only of petroleum of good quality, one variety being much lighter in gravity than the other. There are several well-defined anticlinals in a general southeast-northwest direction, more or less faulted.

The strata containing the petroleum are sandstone, alternating with red or brown shales, which are supposed to be of Devonian age.

The recent developments south of Moncton, New Brunswick, are still progressing, and deeper drilling has developed more productive sands. The production in this field at the close of 1903 is estimated to be close to 100 barrels per day, the product of 15 wells, if pumped to their capacity. The depth varies from 1,000 to 1,500 feet.

Several deep wells drilled within the last four years near Lake Aimslie, Cape Breton, have failed to find petroleum in paying quantities, although the succession of shales and sandstone deposits are quite similar to those of the Pennsylvania productive region.

The development of petroleum already mentioned in a former report in southeast Kootenay district, Alberta, has not as yet taken place. There are some evidences of petroleum springs in this region, and the structural conditions are considered favorable.

NEWFOUNDLAND.

During 1903 another well was drilled near Parsons Pond, on the west coast, to a depth of 1,204 feet, which developed a flow of petroleum.

Two other wells, drilled to a depth of 600 feet, developed considerable natural gas, but no petroleum. Up to this date, 6 wells have been drilled at this locality to a sufficient depth, and 5 of them have found petroleum. The quantity is yet to be determined by pumping them a sufficient length of time to test their output.

No new developments have recently been made at Long Point, where a number of small wells, having a small production, were drilled in former years.

PRODUCTION IN CANADA.

The following is a statement of the production of crude petroleum in Canada for the years 1898 to 1903, inclusive, by districts:

Production of crude petroleum in Canada, 1898–1903, by districts.

[Barrels of 35 imperial gallons, or about 42 standard gallons.]

District.	1898.	1899.	1900.	1901.	1902.	1903.
Petrolia	513,179	a 528,641	541,435	432,906	397,628	350,390
Oil Springs	133,866	b 107,487	99,019	76,059	60,747	56,406
Bothwell	66,404	65,044	47,405	52,873	50,141	48,880
Plympton	25,000	....	....	....	....	....
Dawn	5,923	....	....	....	....	....
Euphemia	5,227	....	....	....	....	....
Zone	901	....	....	....	....	....
Dutton	....	3,622	4,791	10,588	8,867	21,488
Raleigh	....	....	....	....	2,462	1,161
Wheatley	....	....	....	....	....	1,995
Leamington	....	....	....	....	....	1,190
Total	750,000	704,794	692,650	572,416	519,845	481,504

a Includes production from Plympton.
b Includes the production from Dawn, Euphemia, and Zone.

Canadian oils and naphtha inspected, and corresponding quantities of crude oil, 1881–1903.

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	$0.82½	$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	1.02⅝	713,740
1889	9,472,476	24,664,144	100:38	704,690	.92⅝	653,600
1890	10,174,894	26,776,087	100:38	765,080	1.18	902,735
1891	10,065,463	26,435,430	100:38	755,298	1.33⅞	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	1.00⅝	835,322
1895	10,674,232	25,414,838	100:42	726,138	1.49⅝	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	1.48½	1,206,821
1900	13,428,422	24,867,449	100:54	913,498	1.62	1,479,867
1901	a11,123,194	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
1903	7,755,805	18,466,202	100:42	486,637	2.15½	1,048,974

a Petroleum and naphtha.

PERU.

Peru is the only country in South America that refines crude petroleum and secures benzine and refined and lubricating products. The entire production, however, was only 45 per cent of the quantity imported from the United States during 1903. Details of the varied conditions of the industry have been discussed in previous reports.

A United States consular report gives the following extracts taken from a pamphlet published by authority of the Peruvian Government, containing information for the use of prospective investors and settlers in Peru:

Foreigners can become, according to the law, owners of real estate in Peru, subject to the same duties, benefits, and rights as the natives. The code of mines, promulgated July 6, 1900, grants to all persons the right to obtain mining property and to be members of the boards of representatives. The number of concessions demanded should not exceed 60. The greatest industrial development of Peru lies in its gold, copper, and silver mines, its deposits of petroleum, and its mineral-water sources. The mines belong to powerful European and North American syndicates, which are engaged in vigorous prosecution of the works, so that a great output is expected for 1904 and the following years. A tax of 15 soles ($7.30) must be paid every six months for each concession.

The following figures show the concessions made to different persons and societies without distinction as to nationality: 1899, 1,107; 1900, 1,663; 1901, 1,014; 1902 (first six months), 532.

The northern part of the Peruvian coast contains an abundance of coal, petroleum, and naphtha. Coal is found is 23 provinces, and the coal beds being in many places in close proximity to the sea, facilities for its exportation are offered. The principal sources of petroleum are found in the Department of Piura, where the production of each well may be estimated at 136 to 140 hectoliters (3,590 to 3,696 gallons) per day. The petroleum contains very little paraffin. The heavy oils are valuable, being similar to those of Russia. The crude oil can be employed as fuel without other preparation than exposure to the atmosphere in open ponds for a few days.

The following statement of the production of petroleum in 1903, in the Zorritos oil field of Peru, furnished by Mr. Faustino G. Piaggio, who is operating in that field, shows that the production of crude petroleum was 2,060,000 gallons; of refined, 276,100 gallons, and of benzine and gasoline, 61,745 gallons.

Production of petroleum in Zorritos oil field of Peru, 1896–1903.

[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	8,850
1899	3,745,000	806,900	2,541,000	11,220
1900	4,325,000	a 400,000	....	18,000
1901	3,135,000	a 282,480	....	19,060
1902	2,489,500	a 378,250	....	25,920
1903	2,060,000	a 276,100	....	61,745

a Kerosene.

In the course of 1903 a new petroleum company has been formed, which is operating with good results at Punta Lobitos to the north of Talara. Recently also to the south of Zorritos rich deposits of petroleum have been discovered, for the exploitation of which a new company is being formed, and it is quite possible that within a few months the ground may be explored.

COUNTRIES OF THE EASTERN CONTINENT.

RUSSIA.

The facts stated in the following brief summary are derived chiefly from the report of Mr. James C. Chambers, United States consul at Batum, Russia, who, in his report, reduced the poods to United States barrels and gallons.

The decline in the production of crude petroleum in Russia has continued for two years, that for 1903, as compared with 1902, being 4,795,660 barrels, almost identical with the decline in 1902—4,628,512 barrels, as compared with 1901. A serious strike of the workmen in July is estimated to have reduced the output 2,100,000 barrels, and in September a very disastrous fire destroyed 62 rigs, four of which were large flowing wells, involving another loss of production amounting to 2,100,000 barrels in the Bibi-Eibat field, a total of 4,200,000 barrels, which would have brought the production up to a quantity only about 600,000 barrels less than the production for 1902.

FIELD DEVELOPMENT.

There were only 315 wells drilling at the beginning of 1903, as compared with 416 at the beginning of 1902. The production from these new wells was sufficient, however, to have nearly maintained the production. There was a large falling off in production toward the close of the year. The depression in the price of crude at this season always causes a falling off in production and a decrease in new wells. Only 231 new wells were started during the year 1903. There were, however, 23 more wells producing at the close of 1903 than at the close of 1902. The time required to secure a producing well in the Baku field is usually more than a year from the time drilling is commenced, often much longer, and at times they seem to be completed in clusters.

The stocks of crude petroleum at Baku refineries are insignificant, and do not represent over one month's shipment, and from the fact that the production in January, 1904, was 30,000 barrels less than that of one year ago, the outlook for the crude producers in this region for 1904 is encouraging, as the price of the crude is nearly as high as it has ever been, the latest quotation being 7.7 cents per pood of 36.11 pounds—about 65 cents per barrel—while the average cost, it is estimated, can not be greater than from 4.1 to 4.6 cents per pood, or about 38 cents per barrel.

One of the most important events of the year was the reorganization of the leasing of Government tracts in Bibi-Eibat. The high and arbitrary royalty demanded by the Government in this field caused a loss to the operator, when the price declined seriously. The Government was petitioned to change the royalty to a proportion of the petroleum produced. A temporary arrangement requiring the delivery of 30 per cent of the production to the Government was made, pending the rearrangement of the lots, which will again be put up at auction in October, 1904.

One of the remarkable features in all the districts was the steady increase in the water pumped with the petroleum, which, however, did not seriously impair the production of the old wells when they were opened after the strike and fire.

No new territory was developed during the year 1903. The well developed by Nobel Brothers at Berekei, 170 miles north of Baku, mentioned last year, was still producing considerable oil up to the close of 1903. Drilling new wells has continued, but no new production has been secured.

PRODUCTION IN RUSSIA.

Production of crude petroleum in Russia in 1902 and 1903, by fields. (Profitable production.)

Field.	1903.		1902.	
	Poods.	*Barrels.*	*Poods.*	*Barrels.*
Baku	596,581,155	71,618,386	636,529,000	76,414,045
Grosni	33,094,000	3,972,870	34,369,572	4,125,999
Total	629,675,155	75,591,256	670,898,572	80,540,044

By profitable production is meant the quantity actually sold or secured in tanks ready for delivery. The quantity of waste and the quantity consumed as fuel are not included.

Total production of crude petroleum in Russia, 1897–1903.

[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
1903	71,618,386	3,972,870	75,591,256

Comparative production of crude petroleum of Russia and the United States, 1894–1903.

[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
1903	75,591,256	−4,948,788	− 6.1	100,461,337	11,694,421	+13.19	75.25

Percentages of world's production of petroleum in 1901, 1902, and 1903, by countries.

	1901.	1902.	1903.
Percentage of total crude petroleum produced by Russia	51.49	43.50	38.73
Percentage of total crude petroleum produced by the United States	41.97	47.94	51.46
Percentage of all other countries producing petroleum	6.54	8.56	9.81
Total	100.00	100.00	100.00

AUSTRIA-HUNGARY.

GALICIA.

The very remarkable production recently developed near the old city of Boryslaw, in central Galicia, still furnishes a very large percentage of the petroleum produced in this country. This locality was already well known, owing to the remarkable deposit of ozocerite or mineral wax, which closely resembles our crude paraffin or sucker rod wax. About three years ago persons interested were induced to drill a deep test well near this locality, and were repaid by securing a remarkable flow of petroleum. During the years 1902 and 1903 a number of very deep and profitable wells have been secured. Several of them flowed at the rate of over 3,000 barrels per day from a depth of 900 meters or more. Want of facilities for storing and transporting the large amount of petroleum produced in this locality curtailed the production in 1902 and 1903. The output in Galicia during 1903 was 5,234,475 barrels, an increase of nearly 28 per cent over that of 1902, over 80 per cent of which increase came from the vicinity of Boryslaw, district of Drohobycz. The stocks reported amounted to over 1,000,000 barrels at the close of 1903, as compared with 600,000 barrels at the close of 1902.

There are 90 refineries in Austria-Hungary, of which 54 are in Galicia. They are small affairs generally, although several are large, well-equipped refining plants. These refineries treated about 4,800.000 barrels of crude petroleum, producing 1,790,000 barrels of refined products.

Austria-Hungary is also an importer of petroleum. By special concession 140,000 barrels were imported from Roumania into Hungary. Austria also imported illuminating and lubricating oils from Russia, amounting to 145,700 barrels, and from the United States 14,900 barrels, a total of 160,600 barrels during 1903. On the other hand, a very considerable quantity of refined petroleum is exported from Galicia into Germany and Switzerland, which amounted to over 542,000 barrels during 1903.

The indications are that Galicia will yearly become a more important factor in extending its refined products to those countries on its southern and western borders.

Production of crude petroleum in Galicia, 1886–1903, 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.
1903....	727,971	Chiefly Boryslaw.

PRODUCTION IN GALICIA.

In the following table is given a statement of the production of crude petroleum in Galicia from 1886 to 1903, inclusive, as ascertained by the statistical bureau of the Galizischer Landes-Petroleum-Verein, Lemberg:

Production of crude petroleum in Galicia, 1886–1903.

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	1903	7,279,710	5,234,475

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 kilogram=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.

ROUMANIA.

Operations in the development of the petroleum industry in Roumania during 1903 have been extremely active, and the result is an increased production of 34 per cent in 1903 as compared with that of 1902, almost double that of 1899. The production is still, however, but a small part of what the natural resources of Roumania are capable of producing for many years in the future. Gradually the improved methods of production, transportation, refining, and marketing are being introduced, which must sooner or later result in this country becoming a much more prominent factor in the world's markets than it is at present. The great broad curving of the Carpathian Mountains base causes many minor swells in the strata which follow along their flank, producing ideal conditions for the accumulation of petroleum over many miles of area within reasonable depths. A considerable portion of the petroleum continues to be raised in shafts or hand-dug wells.

One of the serious conditions which retard production in a measure is the unsatisfactory method of transporting and marketing the refined products. Roumania is centrally located geographically and borders on several countries, and were it not for the stringent laws and taxes regulating the exportation, Austria and Germany alone would consume its entire production and very much more. It is to the interest of Roumania to facilitate the development of this industry, as the residuum of the refined products is almost its only source of fuel, for which it now depends largely upon foreign countries.

The Prahova district, with Campina as a center, continues to produce about 90 per cent of the entire output, and about 43 per cent of the refined products are manufactured here by the Steaua Romana Company, the Telega Oil Company (Limited) refining about 11 per cent and the International Roumanian Company about 9 per cent, the remainder being absorbed by the smaller refineries. The most important refineries are located at Campina, Baicoi, Plopeni, and Tergoviate.

There were 295,087,950 kilos of refined products secured during 1903, as compared with 202,872,350 kilos during 1902, which quantities were divided among the several products as given in the following table for the years 1902 and 1903, in kilograms of 2.0246 pounds:

Refined products of Roumanian petroleum in 1902 and 1903.

Products.	1902.	1903.
	Kilograms.	*Kilograms.*
Benzine	31,166,618	48,225,279
Illuminating petroleum	56,814,913	76,443,449
Lubricating petroleum	3,355,170	3,719,616
Residuals and inferior lubricants	111,535,649	166,699,606
Total	202,872,350	295,087,950

The decline in the consumption of illuminating petroleum when there was an increase in the production is to be regretted, but, on the other hand, the increase in the consumption of benzine is very gratifying, especially as during the year just concluded, it found a new competitor in alcohol, which, by a special law passed in Parliament, has come on the market for industrial purposes in competition with benzine.

The prices for various petroleum products at the beginning of the year and at the end, as quoted in the Moniteur du Pétrole Roumain, on the home market were:

Prices of Roumanian petroleum, in francs, per ton.

	Beginning of year.	End of year.
	Francs.	*Francs.*
Crude oil	21.00	30.00
Illuminating oil	100.00	120.00
Benzine	180.00	160.00
Residuals	34.00	35.00
For export:		
Illuminating oil in cases	41.00	65.00
Benzine	65.00	80.00

Although the production is growing continuously the prices remain firm, which is to be explained by the fact that the largest part of the production is in strong hands, which absorb also the production of the minor firms, so that the latter can profit by the good prices.

The total amount of refined petroleum exported from Roumania was 126,277,410 kilograms, equal to 850,000 barrels, which went to Austria, England, Germany, France, Turkey, and Bulgaria. There is considerable variation in the proportion of the lighter products of naphtha and illuminating petroleum in different localities. The lighter crudes secured at Cochin, Campina, Baicoi, and Bustenari give from 37 to 45 per cent of lighter grades when distilled, with considerable variation in the proportion of naphtha and illuminating products, up to 150° Centigrade. Some of the heavier varieties only produce 20 per cent when distilled up to 150° centigrade. Nearly all of the crude produced in Roumania contains paraffin. The crudes produced in the Campina and Moinesti fields are usually quite rich in paraffin, but that produced in the Bustenari field contains only a small percentage. Owing to the large percentage of paraffin in a large proportion of the crude produced only a few of the distillates can be used for lubricating purposes without further treatment. The proportion of sulphur in the Campina crude amounts to 0.18 per cent.

During 1903 a very interesting report on the physical and chemical properties of crude petroleum produced in Roumania by Dr. L. Edeleano, of the department of mines, and Mr. I. Tanasesco, mining engineer, was presented to the Congress for the development of science, Bucharest, October, 1903.

PRODUCTION OF CRUDE PETROLEUM.

The production of the last eleven years was as follows:

Production of crude petroleum in Roumania, 1893–1903.

Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*
1893	56,600	1899	250,000
1894	64,530	1900	250,000
1895	76,000	1901	270,000
1986	80,000	1902	310,000
1897	110,000	1903	384,303
1898	180,000		

GERMANY.

There has been a gradual increase in the production of petroleum in Germany commencing with 1899. Since that year it has more than doubled its output. This increase is due to the operations near Weitze, in Hanover. At present many new companies are forming, and there is a large amount of drilling going on near the city of Braunschweig and extending northwest for 40 miles to Weitze. Near the latter a number of wells have been drilled from 350 to 420 meters deep. The petroleum secured is dark in color, and is from 0.94 to 0.95 in specific gravity, the deeper wells furnishing an oil that is slightly lighter in gravity. This field produced 296,830 barrels in 1903. At Piene, near Celle, about 40 per cent of the crude is a very remarkable lubricating oil, 20 per cent is spindle oil, 6 per cent is yellow illuminating petroleum, 6 per cent is water-white petroleum, and 5 per cent is benzine, 23 per cent being residuum and loss. The other field is 300 miles southwest, in Alsace, at Pechebroun, which for many years has produced from 100,000 to 160,000 barrels of crude petroleum annually. This is also a heavy petroleum, and is nearly all refined at Pechebroun and Bodromstein, the products being also largely lubricating petroleum. The total production of crude petroleum in these two fields during 1903 was 445,818 barrels, a gain of 26 per cent over the production of 1902.

Germany encourages the development of her petroleum fields by imposing on all of the petroleum products brought into the country heavy import duties, amounting to $2 per barrel on illuminating petroleum and to 10 marks, or $3.33, per 100 kilos on lubricating petroleum.

The total of crude and refined products imported into Germany from the United States during 1903 was 131,464,300 gallons; Russia furnished about 32,500,000 gallons, and all other countries about 26,000,000 gallons. The United States, therefore, furnished about 69 per cent of all the petroleum imported by Germany, Russia 16.5 per cent, and all other countries 14.5 per cent. A large proportion of the petroleum imported from Russia was lubricating products. The illuminating petroleum imported from the United States is superior to all others, being lighter in gravity, which according to the present duties gives it a slight advantage and causes it to command a higher price in the general market.

PRODUCTION.

The production and value of petroleum in Germany from 1880 to 1903 is shown in the following table:

Production and value of petroleum in Germany, 1880–1903.

[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
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
1903	62,680	445,818	4,334,000	1,040,160

[a] One metric ton, crude=7.1126 barrels. [b] One mark taken as=24 cents.

Production of petroleum in Alsace-Lorraine, 1880–1903.

Year.	Quantity.		Year.	Quantity.	
	Metric tons.	Barrels.		Metric tons.	Barrels.
1880	1,063	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	134,3[illegible]
1885	3,087	21,956	1897	20,703	147,2[illegible]
1886	7,696	54,738	1898	23,282	165,[illegible]
1887	7,892	56,133	1899	23,554	167,5[illegible]
1888	9,150	65,080	1900	22,597	160,72[illegible]
1889	6,532	46,759	1901	19,997	142,2[illegible]
1890	12,977	92,300	1902	20,205	143,710
1891	12,817	91,162	1903	20,947	148,9[illegible]

ITALY.

The statistics of production in Italy for 1903 are not yet obtainable The production for 1902 was nearly 19,000 barrels, which is the largest quantity produced since 1895, yet it is small in comparison to the world's production, amounting to but one-hundredth of one per cent of the world's output in 1903. There is a great variety in the gravity and the color of the petroleum found in Italy. A large portion of it is found in the field on the northern flanks of the Apennines and is light and almost transparent, and of a gravity of 0.725. Near Giovanni Incarico a dark heavy oil of a specific gravity of 0.983 was produced. Asphalt is also found in localities. There are traces of a dark green petroleum found in Sicily. The main production, however, continues to come from the province of Piacenza, near the town of Velloi, where over 300 wells have been drilled to a depth of from 300 to 600 meters. There is a considerable quantity of natural gas produced in this locality, and also at Salzo Maggiore, a town of 10,000 inhabitants, large flows of natural gas were encountered with some shows of petroleum. It is reported that sufficient natural gas has been produced from two wells near this last-named locality to supply the entire lighting of this town for several years past.

GREAT BRITAIN.

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 a coal mine in Derbyshire, which is given in the following table. None, however, has been reported for 1903. 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. Some natural gas with showings of petroleum have recently been developed at Netherfield, in Sussex.

PRODUCTION AND VALUE.

The mineral statistics of the United Kingdom give the production and value of petroleum from 1886 to 1903 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

[a] Value at wells. £1=$4.86.

Production and value of petroleum in Derbyshire, England, 1896–1902—Continued.

Year.	Production.		Value.	
	Tons (2,240 pounds).	Barrels (42 gallons).	Pounds sterling.	Dollars.
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	....	....

SCOTCH SHALE-OIL INDUSTRY.

This industry has continued for a number of years, notwithstanding the introduction of the products of crude petroleum imported from the United States and Russia. The combined annual production of all of the shale-oil manufactories has for a number of years been about 150,000 barrels of heavy naphtha, about 500,000 barrels of burning oil of a very high-flash test, probably 300,000 barrels of lubricating oils, and 20,000 tons of solid paraffin, which is derived from about 2,250,000 tons of shale mined and treated in refineries.

In the following table is given the quantity and value of oil shale produced in Great Britain during the years 1897 to 1903, inclusive:

Quantity and value of oil shale produced in Great Britain, 1897–1903.

Country.	1897.		1898.		1899.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.		*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	2,279,879	£626,966
Wales	1,560	390	1,609	402	2,375	891	2,342	578
Total	2,223,745	555,936	2,137,993	534,498	2,210,824	553,003	2,282,221	627,544

Country.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*		*Tons.*	
England	....	....	....	....	....	....
Scotland	....	....	2,105,953	....	....	....
Wales	....	....	1,581	....	....	....
Total	2,354,356	....	2,107,534	....	2,009,602	....

The quantity and value of oil shale produced in Great Britain from 1873 to 1903 are shown in the following table:

Production of oil shale in the United Kingdom, 1873–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Statute tons.			*Statute tons.*	
1873	524,095	£262,047	1889	2,014,860	£503,715
1874	362,747	181,373	1890	2,212,250	608,369
1875	437,774	218,887	1891	2,361,119	707,177
1876	603,538	301,769	1892	2,089,937	522,484
1877	801,701	400,850	1893	1,956,520	489,130
1878	788,704	394,352	1894	1,986,385	496,596
1879	783,748	391,824	1895	2,246,865	561,716
1880	837,805	418,902	1896	2,419,525	604,881
1881	958,255	479,127	1897	2,223,745	555,936
1882	1,030,915	310,685	1898	2,137,993	534,498
1883	1,167,943	299,676	1899	2,210,824	553,003
1884	1,518,871	388,780	1900	2,282,221	627,844
1885	1,770,413	447,302	1901	2,354,356	....
1886	1,728,508	435,963	1902	2,107,534	....
1887	1,411,878	355,085	1903	2,009,602	....
1888	2,076,469	519,074			

DUTCH EAST INDIES—SUMATRA, JAVA, AND BORNEO.

There was continued activity in these petroleum-producing islands of the east during the year 1903, although complete figures are very difficult to secure at this date. The inferior quality of the petroleum produced in Borneo is largely marketed for fuel. Java produces a petroleum rich in paraffin. Sumatra is by far the largest producer, yielding about 75 per cent of the entire production of these islands. The principal refineries are located in Sumatra. The oldest and most successful producers of refined products is the Royal Dutch Petroleum Company; next in order of production is the Moeara Enim Petroleum Company. The Dordtsche Petroleum Company of Java is the oldest organization, dating back to 1890.

The refineries in Sumatra during the years 1899 and 1900 had to build many miles of pipe line to newly developed fields to secure their supply of crude petroleum, as the wells supplying the original refineries suddenly ceased to flow or to pump any large quantity of petroleum just after they were fully equipped, salt water having invaded the whole territory. This condition cut down the production in the year 1899 and 1900 to less than one-third of what it was in 1898. To secure new production, pipe lines from 40 to 120 miles in length were constructed which involved a large amount of outlay for their completion and equipment, but enabled the production of Sumatra to be more than regained.

During 1890 the Shell Transport and Trading Company began operations in Borneo in the development of the crude petroleum which is largely used as fuel, and it has been successful in increasing the output every year. This 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 in Russia, and has erected storage tanks at the following-named seaports: In Africa, at Port Tenenk, at Port Said, on the Suez Canal, 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 10 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 in this region as its merits become more generally known. 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, and the new areas of fuel petroleum that have lately been developed in these islands and in other portions of the globe, all seem to show that an increasing amount of coal must be annually supplanted by liquid petroleum as a fuel.

THE ILLUMINATING PRODUCTS OF DUTCH EAST INDIA.

The refined products of the petroleum produced in Dutch East India do not compare in quality with those of the United States, and are also inferior to much that is manufactured in Russia. They are sold at prices that are less than those obtained for the American and the Russian articles.

The great masses of the natives of these islands and of the surrounding countries—China, India, and Siam—are satisfied with an inferior grade of cheap petroleum, as they consume it generally in crude clay lamps without chimneys. They claim that the smoke drives off the mosquitoes and kills the malaria.

PRODUCTION.

The production of these three islands is estimated as follows for the years 1901, 1902, and 1903:

Production of petroleum in Sumatra, Java, and Borneo in 1901, 1902, and 1903.

Country.	1901.	1902.	1903.
	Barrels.	*Barrels.*	*Barrels.*
Sumatra	3,100,000	4,200,000	4,880,000
Java	615,000	750,000	680,000
Borneo	460,000	910,000	1,080,000
Total	4,175,000	5,860,000	6,640,000

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, 1901, and 1902:

Production of petroleum in the Dutch East Indies in 1900, 1901, and 1902.

Country.	1900.		1901.		1902.	
	Crude.	Refined.	Crude.	Refined.	Crude.	Refined.
Borneo .... tons [a]	59,352		85,554	24,617	[c] 84,282	[d] 14,215
Java .... liters [b]	97,308,800		102,797,300		63,182,955	20,290,000
Sumatra .... do		117,109,600		264,320,500		143,042,630

[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).
[c] Includes 82,882 tons "liquid fuel" and 1,400 tons crude oil.
[d] Includes 14,207 tons kerosene and 8 tons "solar distillate."

Quantity and value of refined petroleum imported into the Dutch East Indies from the United States, 1890–1903.

Year ending June 30—	Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*	
1890	18,420,126	$1,754,827		
1891	21,633,290	2,052,937		
1892	17,017,200	1,302,676		
1893	15,560,640	1,106,523		
1894	26,316,369	1,637,149		
1895	15,155,540	1,068,715		
1896	16,947,880	1,427,770		$1,041
1897	24,989,000	1,851,887		7,696
1898	12,534,930	809,063		7,795
1899	15,371,400	1,189,329	60,909	11,972
1900	11,207,740	1,061,700	85,866	12,751
1901	17,044,320	1,492,490	94,966	16,454
1902	15,025,710	1,363,079	240,400	33,087
1903	9,210,520	864,300	226,436	33,668

PHILIPPINE ISLANDS.

Crude petroleum is reported to exist in the southern portion of Luzon, the western portion of Panay, the central portion of Negros, and in a number of other islands that compose the group. Some of them are worked in a very crude manner by the natives. As yet nothing definite in the way of developing these resources has been accomplished.

Imports of petroleum from the United States into the Philippine Islands in the years ending June 30, 1901, 1902, and 1903, by kinds of oil.

Kind of oil.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Gallons.		*Gallons.*		*Gallons.*	
Naphtha	1,050	$206	315,100	$27,845	29,000	$5,715
Illuminating oil	1,208,100	108,000	1,971,100	166,670	2,803,101	265,624
Lubricating oil	38,743	11,218	319,639	40,882	57,006	8,309
Total	1,247,893	119,424	2,605,839	235,397	2,889,107	279,648

Quantity and value of refined mineral oils imported from the United States into the Philippine Islands, 1899–1903.

Year.	Quantity.	Value.
	Gallons.	
1899	11,297	$2,870
1900	617,849	65,120
1901	1,312,366	119,571
1902	3,451,903	307,994
1903	3,604,654	428,246

JAPAN.

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. During 1903 several wells were drilled in the Ishikari district which indicated the presence of petroleum in quantity; later tests, however, have given rather discouraging results. There are indications of petroleum scattered over a large portion of this northern island of Japan, and there are also indications of petroleum on the island of Formosa, and some small production in a primitive way.

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 1,600 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 present production is maintained by the deepening of many of the wells that have exhausted the upper pay.

The formation 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 formation varies 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 natually 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.

The average amount of marketable products secured from the crude 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 32° 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 2½ to 3 yen per koku, or from $1.10 to $1.25 per barrel.

The daily production, by districts, in Echigo in 1902 and 1903 was as follows:

Daily production in Echigo in 1902 and 1903, by districts.

[Barrels of 42 gallons.]

District.	1902.	1903.
Nagamine, Kamada, and other districts adjacent	1,280	1,120
Nagioka	980	850
Higashi	360	320
Nūtsu	650	650
Total daily production	3,270	2,940

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
Nūtsu	65	....	180	245
Total	451	148	228	827

PRODUCTION.

Production of petroleum in Japan, 1875–1903.

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				
1903	[f] 853,097	40,487,984				

[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.

[f] Estimated.

INDIA.

Almost the entire production of India comes from two districts in upper Burma, known as the Pakokku and Magwe provinces. The localities producing the petroleum are known as the Yengenyat and the Yengenyoung fields. There is also some production in the districts of Myngyan and Kyankpyu. All these localities are close to the great Irawaddy River. Yengenyoung is 300 miles northwest of Rangoon and Yengenyat is 50 miles north of Yengenyoung. Upper Assam produces a small quantity. There is also a small production of a very superior oil in the district of Akayab, on the islands of Cheduba and Ramree. In past years there was considerable production in Punjab, which is at present almost abandoned.

There are about 65 producing, cable-drilled wells in Yengenyat, and about 115 producing wells in Yengenyoung localities that range from 700 to 1,300 feet in depth. In the latter district about 750 barrels are produced daily from many 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.

PRODUCTION.

The following table gives the production of petroleum in India from 1889 to 1903, in imperial gallons reduced to barrels of 42 gallons and in rupees reduced to dollars:

Production and value of petroleum in India, 1889-1903.

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	204,719
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	1,058,567
1903	87,859,069	2,510,259	5,315,470	1,722,212

The value of the rupee on January 1, 1885, in United States money was 37.8 cents; 1886, 36.7 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; 1903, 32.4 cents.

CHINA.

The importation of petroleum products from the United States into China was not so large during 1903 as it was for the year 1902, as large quantities were held over from the previous year. However, it will be found upon examination of the following tables that the quantities exported from Russia and Sumatra have suffered slightly more in their proportion of the decrease than did the United States.

It is reported that the value of the illuminating products of petroleum, known as kerosene oil, imported into China from the chief sources of its production during 1903 was as follows:

United States	$4,275,200
Sumatra	4,240,640
Russia	1,428,480
Total	9,944,320

In Manchuria there was quite a recovery in the kerosene trade for the year, but large quantities are held over. The increased consumption of oil is noticed all over Manchuria, and is especially observed in all the cities under Russian administration.

The Russian Oil Company is constructing tanks in the principal towns, and will carry the kerosene in tank cars to all towns along the railway line. This system is in course of construction, but is not yet complete. This will give the Russian oil a great advantage in the trade. Russian oil is sold throughout Manchuria at from 20 to 70 cents per case less than United States oil.

In the northern part of Manchuria, with Harbin as a center, Russian oil is fast supplanting the United States product. There is no way of ascertaining the quantity of Russian oil coming annually into Manchuria, but it is fast assuming large proportions. Kerosene oil was imported into Niuchwang during the year 1903 as follows: American, 485,381 haikwan taels ($315,497); Russian, 25,000 haikwan taels ($16,250).

PETROLEUM ON THE ISLAND OF SAKHALIN.

This island belongs to Russia and lies on the southeastern border of Siberia immediately north of the Japanese island of Hokkaido or Ezo. Petroleum deposits are reported in both the southern and the northern portions of this island.

According to the description of the mining engineer, L. Batzevitch, deputed to Sakhalin in 1889, the petroliferous area is situated on the northern extremity of the island on the eastern slope of the mountain range which traverses the middle of the island from north to south, and here are to be found outcrops of petroleum and deposits of asphalt. For determining the character of the formations several shafts were sunk, and it was ascertained that by their geological age the formations belong to Miocene deposits of the Tertiary system; and, as is the case in most oil fields, here also are to be noted anticlinal folds in the strata.

Analyses have been made which have proved that Sakhalin crude oil has a specific gravity at 17.5° C. of 0.899, and represents an oxidation of a lighter crude to be found at a greater depth. The specific gravity of the fractions remind one of Baku oil, and the fractions received up to 250° C. represent a high-class illuminating oil, of which a yield of about 30 per cent can be obtained from the crude.

The petroleum deposits in southern Sakhalin are situated among the hills covered with bogs on both banks of the river Niuta, and the petroliferous formation is covered on top with deposits of recent origin. The oil comes out on the surface in the valleys. It stretches along for a distance of 2 miles, forming a continuous row of large and small shining black patches, which stand out clearly among the surrounding verdure. The width of this belt is only several sagenes. It is presumed that the oil pools were formed in those places where the axis of the anticlinal running from north to south has been washed away and the oil-bearing formation appears on the surface. The deposits on the river Niuta have not been worked yet, but claims are already staked out, and Mr. Kleie, who has secured a concession about 25 miles from the town of Niutovo, has already made arrangements with an English company for its development.

WORLD'S PRODUCTION.

The following table gives the entire production of crude petroleum in all the known countries for 1901, 1902, and 1903, and under the head of "All other countries" an estimate of the quantity produced in countries which are known to have a limited production of petroleum, but from which no actual figures could be secured.

Several of the South American States and Mexico are known to have a small production of crude petroleum; also Algeria, Persia, China, and the Philippines.

There was a remarkable increase in nearly every one of the countries producing petroleum in 1903, except in Russia, which showed a decline in both 1903 and 1902.

The United States, owing to the large production in the new fields of California and Texas, has continued to increase in production, until in 1903 it produced more than one-half of the entire product of the world.

The increase in the world's production in 1903 compared with 1902 amounted to 10,045,150 barrels, equal to 5.4 per cent; the increase in 1902 was 19,384,661 barrels, or 11.7 per cent over 1901.

The most conspicuous items shown in the table for 1903 are the increase of 11,694,421 barrels in the production of the United States over that of 1902, and the decrease in the production of Russia of 4,948,789 barrels in 1903 when compared with the production of 1902.

The United States and Russia combined continue to furnish the great bulk of the world's production, amounting in 1903 to 90.19 per cent as compared with 91.44 per cent in 1902 and 93.22 per cent in 1901, although the combined production of all the other countries increased in percentage. Galicia, Roumania, and India combined produced 8.78 per cent of the total in 1903, leaving less than 1 per cent to be supplied by all of the remaining countries.

The following table shows the world's production of crude petroleum in 1901, 1902, and 1903:

World's production of crude petroleum in 1901, 1902, and 1903.

[Barrels of 42 United States gallons.]

Country.	1901.		1902.		1903.	
	Quantity.	Percentage of total.	Quantity.	Percentage of total.	Quantity.	Percentage of total.
United States	69,389,194	41.84	88,766,916	47.94	100,461,337	51.46
Canada	572,500	.35	520,000	.28	481,504	.25
Peru	72,261	.04	60,000	.03	61,745	.03
Russia	85,168,556	51.38	80,540,045	43.50	75,591,256	38.73
Galicia	3,251,544	1.96	4,142,160	2.24	5,234,475	2.67
Sumatra, Java, and Borneo	3,038,700	1.84	5,860,000	3.17	6,640,000	3.40
Roumania	1,406,160	.85	2,059,930	1.11	2,763,117	1.42
India	1,430,716	.86	1,617,363	.87	2,510,259	1.29
Japan	1,100,000	.67	1,193,000	.64	964,000	.49
Germany	313,630	.19	353,675	.20	445,818	.23
Italy	10,100	.02	18,933	.02	20,000	.03
All other countries	20,000		26,000		30,000	
Total	165,773,361	100.00	185,158,022	100.00	195,203,511	100.00

This table is one of production, irrespective of quality and value. The quality of the greater portion of the petroleum produced in the United States is more valuable than that from any other country, as more than double the quantity of high-priced products are secured in the process of refining than it is possible to secure from the Russian or most of the other foreign petroleums. All crude petroleum has, however, nearly the same amount of heating power when used as fuel.

The following table is compiled upon the assumption that there are 50 per cent of the refined products secured from the entire production of the United States in 1903, as compared with 20 per cent refined products secured from the Russian production and 25 per cent from the production of all remaining countries.

Approximate production of refined products in the United States, Russia, and all other countries in 1903, and the percentages of the same.

Country.	Quantity.	Proportion.
	United States gallons.	*Per cent.*
United States	2,109,688,077	71.6
Russia	634,966,550	21.6
All other countries	201,084,664	6.8
Total of all countries	2,945,739,291	100.0

The United States therefore produced 2.5 barrels of refined products in 1903 for every barrel produced by the rest of the world.

The purest and most valuable grades of crude petroleum in the 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.[a]

By F. H. Oliphant.

INTRODUCTION.

The following are the most conspicuous features in the production and consumption of natural gas in the United States for the year 1903:

(1) The production was greater than in any previous year, and was valued at $35,815,360.

(2) There was a large increase in the production of 1903 over that of 1902.

(3) Four States, namely, Pennsylvania, West Virginia, Indiana, and Ohio, produced 94 per cent of the value of natural gas in 1903. All of these States showed substantial gains, except Indiana, which had a decreased production in 1903 as compared with 1902.

(4) The volume of natural gas produced in 1903 amounted to 238,769,067,000 cubic feet at atmospheric pressure and represented approximately 5,968,725 tons. If the density should remain the same throughout, this quantity would fill a reservoir whose base was 1 square mile to a height of 1.62 miles; it would fill a pipe that encircled the earth at the equator and that had an internal diameter of 49 feet. Its heating value would equal 11,938,453 tons of bituminous coal.

(5) There were 627,047 domestic consumers and 7,222 manufacturers, a total of 634,269 persons, firms, and corporations, who were supplied with light, heat, and power. A careful estimate puts the number of individuals benefited at not less than 4,500,000.

(6) A large amount of money was expended in 1903 in building large mains for conveying natural gas, in equipping new compressing stations, and in drilling gas wells, mainly in Ohio, West Virginia, Pennsylvania, and Kansas.

(7) The United States produced 99½ per cent of the entire world's production of natural gas.

INCREASE IN VALUE OF PRODUCTION.

The increase in value of the production of natural gas in 1903 was $4,947,497, or 16 per cent, as compared with 1902. There was a remarkable increase in Pennsylvania and Ohio, amounting respectively to $1,830,651 and $2,123,582, and West Virginia gained $1,492,178.

[a] The tables in this report were compiled by Miss Belle Hill, special agent U. S. Geological Survey, Pittsburg, Pa.

Of the total value of all the natural gas produced in the United States during 1903 Pennsylvania furnished 45.18 per cent, West Virginia 19.2 per cent, Indiana 17 per cent, Ohio 12.5 per cent, Kansas 3.14 per cent, New York 1.35 per cent, leaving a little less than 2 per cent for all of the remaining States and Territories. Only in the State of Kansas did the value of the natural gas exceed that of the petroleum.

Louisiana is the only State producing petroleum in any quantity that did not produce any natural gas to be sold, or even to be consumed by the producer.

The general average of the price received for the sale of natural gas in 1903 was very slightly greater than in 1902, being about 15 cents per 1,000 cubic feet at an average pressure of about 4 ounces per square inch.

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 1890 to 1903, by States:

Approximate value of natural gas produced in the United States, 1890–1903, by States.

State.	1890.	1891.	1892.	1893.	1894.	1895.	1896.
Arkansas	a $6,000	$250	$100	$100	$100	$100	$60
California	33,000	30,000	55,000	62,000	60,350	55,000	55,682
Colorado					12,000	7,000	4,500
Illinois	6,000	6,000	12,988	14,000	15,000	7,500	6,375
Indiana	2,302,500	3,942,500	4,716,000	5,718,000	5,437,000	5,203,200	5,043,635
Kansas	12,000	5,500	40,795	50,000	86,600	112,400	124,750
Kentucky	30,000	38,993	43,175	68,500	89,200	98,700	99,000
Missouri	10,500	1,500	3,775	2,100	4,500	3,500	1,500
New York	552,000	280,000	216,000	210,000	249,000	241,530	256,000
Ohio	4,684,300	3,076,325	2,136,000	1,510,000	1,276,100	1,255,700	1,172,400
Pennsylvania	9,551,025	7,834,016	7,376,281	6,488,000	6,279,000	5,852,000	5,528,610
South Dakota	(a)						
Texas	(a)		100	50	50	20	
Utah	(a)			500	500	20,000	20,000
West Virginia	6,400	35,000	500	123,000	395,000	100,000	640,000
Other States	1,600,000	250,000	200,000	100,000	50,000	50,000	50,000
Total b	18,792,725	15,500,084	14,800,714	14,346,250	13,954,400	13,006,650	13,002,512
State.	**1897.**	**1898.**	**1899.**	**1900.**	**1901.**	**1902.**	**1903.**
Arkansas and Wyoming	c $40						$2,460
California	50,000	$65,337	$86,891	$79,083	$67,602	$120,648	104,521
Colorado	4,000	3,300	1,480	1,800	1,800	1,900	14,140
Illinois	5,000	2,498	2,067	1,700	1,825	1,844	3,310
Indiana	5,009,208	5,060,969	6,680,370	7,254,539	6,954,566	7,081,344	6,098,364
Indian Territory and Oklahoma						360	1,000
Kansas	105,700	174,640	332,592	356,900	659,173	824,431	1,123,849
Kentucky	90,000	103,133	125,745	286,243	270,871	d 365,656	d 390,601
Missouri	500	145	290	547	1,328	2,154	7,070
New York	200,076	229,078	294,593	335,367	293,232	346,471	493,686
Ohio	1,171,777	1,488,308	1,866,271	2,178,234	2,147,215	2,355,458	4,479,040
Pennsylvania	6,242,543	6,806,742	8,337,210	10,215,412	12,688,161	14,352,183	16,182,834
South Dakota			3,500	9,817	7,255	10,280	10,775
Texas		765	8,000	20,000	18,577	14,953	21,351
Utah	15,050	7,875					
West Virginia	912,528	1,334,023	2,335,864	2,959,032	3,954,472	5,390,181	6,882,359
Other States	20,000	20,000					
Total b	13,826,422	15,296,813	20,074,873	23,698,674	27,066,077	30,867,863	35,815,360

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.
c Value of gas in Arkansas only.
d Includes small quantity produced in Tennessee.

VALUE OF NATURAL GAS AND PETROLEUM AND THEIR COMBINED VALUE, BY STATES, IN 1903.

The combined value of natural gas and petroleum produced by twenty States and Territories amounted, in 1903, to $130,509,410, which is greater by $28,462,637 than $102,046,773, the combined value in 1902. Of the combined value for 1903, 27.4 per cent is the proportion furnished by sales of natural gas and 72.6 per cent is the proportion furnished by the sales of petroleum. The value of all the coal produced in the United States in 1903 was $503,724,381. In 1902 the proportion of the value of the natural gas to the petroleum produced was as 30.2 per cent to 69.8 per cent, a comparative decrease in 1903 of 2.8 per cent.

The following tables give the value of natural gas and of petroleum and their combined value in 1902 and 1903, by States, arranged in the order of the value of the combined production:

Value of the natural gas and petroleum produced in 1903, and their combined value, by States.

State.	Value of natural gas.	Value of crude petroleum.	Value of natural gas and crude petroleum.
Pennsylvania	$16,182,834	$18,170,881	$34,353,715
Ohio	4,479,040	26,234,521	30,713,561
West Virginia	6,882,359	20,516,532	27,398,891
Indiana	6,098,364	10,474,127	16,572,491
Texas	21,351	7,517,479	7,538,830
California	104,521	7,399,349	7,503,870
New York	493,686	1,849,135	2,342,821
Kansas	1,123,849	988,220	2,112,069
Kentucky and Tennessee	390,601	486,083	876,684
Colorado	14,140	431,723	445,863
Louisiana	....	416,228	416,228
Indian and Oklahoma Territories	1,000	142,402	143,402
Arkansas and Wyoming	2,460	62,720	65,180
Missouri and Michigan	7,070	4,650	11,720
South Dakota	10,775	....	10,775
Illinois	8,310	....	8,310
Total	35,815,360	94,694,050	130,509,410

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	$14,352,183	$15,266,093	$29,618,276
Ohio	2,355,458	20,757,359	23,112,817
West Virginia	5,390,181	17,040,317	22,430,498
Indiana	7,081,344	6,526,622	13,607,966
California	120,648	4,873,617	4,994,265
Texas	14,953	3,998,097	4,013,050
New York	346,471	1,530,852	1,877,323
Kansas	824,431	292,464	1,116,895
Kentucky and Tennessee	365,656	141,044	506,700
Colorado	1,900	484,683	486,583
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	30,867,863	71,178,910	102,046,773

NUMBER OF COMPANIES, VALUE OF NATURAL GAS CONSUMED, AND VALUE OF OTHER FUEL DISPLACED BY NATURAL GAS, IN 1903, BY STATES.

The following table gives in the first column the number of companies and individuals reporting in the several States, amounting to 2,329 in 1903, as compared with 2,147 in 1902, a gain of 182. In Pennsylvania, New York, and Ohio there are numerous small wells which supply a single fire each in half a dozen houses. Many consolidations of large companies have taken place during the year, especially in Pennsylvania. The second column gives the value of the gas consumed. In the third column is found the estimated value of coal and wood or other fuel that would have been required to replace the natural gas, consumed during 1903. The value of other fuel saved by the natural-gas engine is now a very important item.

The saving in 1903 amounted to $9,224,429, or about 26 per cent, more than the value of natural gas. In many of the Lake cities and towns high-priced anthracite coal has been replaced by natural gas. Better prices were secured in the sale of natural gas in Indiana and Kansas during 1903 than in former years.

The economy with which natural gas can be transferred to widely separated points by pipe lines has made it possible for one State to market large quantities of it in adjoining States, even when points of production are more than 200 miles distant from those of consumption. On comparing the table of natural-gas consumption with that of production, it will be noticed that Pennsylvania consumed slightly less natural gas than it produced. A considerable portion of the natural gas produced in northern Pennsylvania was sold in New York. On the other hand West Virginia furnished large amounts of natural gas to western Pennsylvania. Ohio, notwithstanding the newly developed fields, produced but 62 per cent of its consumption; the remaining 38 per cent was furnished chiefly by West Virginia, with considerable quantities from Kentucky, Pennsylvania, and Indiana. Indiana consumed a large proportion of its production. West Virginia's consumption was only 45.4 per cent of the value of its natural-gas production, large quantities going to Pennsylvania and Ohio. A small quantity was consumed in West Virginia that was produced in Pennsylvania and Kentucky. Kentucky furnished some natural gas to Ohio and West Virginia. Kansas and all the remaining States and Territories consumed all the natural gas produced within their borders.

Value of natural gas consumed in the United States in 1903, by States, and the value of coal or wood displaced by same, as reported by 2,329 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] 414	$16,060,196	$20,075,245
Ohio	[b] 515	7,200,867	8,155,570
Indiana	924	5,915,367	8,281,515
West Virginia	88	3,125,061	4,375,000
New York	[c] 144	1,944,667	1,992,726
Kansas	120	1,123,849	1,676,351
Keutucky	20	280,426	311,555
Tennessee	2	300	300
California	24	104,521	104,521
Colorado	4	[d] 14,140	14,140
Texas	6	21,351	21,351
South Dakota	4	10,775	17,575
Missouri	18	7,070	7,070
Illinois	39	3,310	3,310
Arkansas and Wyoming	2	2,460	2,460
Indian and Oklahoma Territories	5	1,000	1,000
Total	2,329	35,815,360	45,039,689

[a] Includes 111 individual producers in Erie County, the product of whose wells is principally for their own domestic consumption.
[b] Includes 386 individual producers in Ashtabula, Cuyahoga, Lake, and Lorain counties, the product of whose wells is principally for their own domestic consumption.
[c] Includes 77 individual producers in Chautauqua County, the product of whose wells is principally for their own consumption.
[d] Largely used for illuminating purposes.

The following table gives the value of the natural gas consumed in the States named from 1899 to 1903, inclusive:

Value of natural gas consumed in the United States, 1899–1903, by States.

State.	1899.	1900.	1901.	1902.	1903.
Pennsylvania	$7,926,970	$9,812,615	$11,785,996	$13,942,783	$16,060,196
Indiana	a 5,833,370	a 6,412,307	a 6,276,119	a 6,710,080	a 5,915,367
Ohio	3,207,286	3,823,209	4,119,059	4,785,766	7,200,867
West Virginia	1,310,675	1,530,378	2,244,758	2,473,174	3,125,061
New York	1,236,007	1,456,286	1,694,925	1,723,709	1,944,667
Kansas	332,592	356,900	659,173	824,431	1,123,849
Kentucky and Tennessee	125,745	194,032	187,660	255,781	280,726
California	86,891	79,083	67,602	120,648	104,521
Texas	8,000	20,000	18,577	14,958	21,351
South Dakota	3,500	9,817	7,255	10,280	10,775
Missouri	290	547	1,328	2,154	7,070
Colorado	1,480	1,800	1,800	1,900	14,140
Illinois	2,067	1,700	1,825	1,844	3,310
Indian and Oklahoma Territories				360	1,000
Arkansas and Wyoming					2,460
Total	20,074,873	23,698,674	27,066,077	30,867,863	35,815,360

a A portion of this was consumed in Chicago, Ill.

USES OF NATURAL GAS.

In the following table are specified the uses to which the natural gas produced in the United States in 1903 was put:

Uses to which natural gas produced in the United States in 1903 was put, as reported by 2,329 persons, firms, and corporations.

State.	Companies or individuals reporting.	Domestic consumers supplied.	Establishments supplied.				
			Iron mills.	Steel works.	Glass works.	Other establishments.	Total.
Pennsylvania	414	214,432	80	66	122	2,616	2,884
Ohio	515	197,710	5	14	63	1,704	1,786
Indiana	924	90,118	18	5	130	867	1,020
West Virginia	88	36,179	1	8	25	1,088	1,122
New York	144	57,935			5	203	208
Kansas	120	15,918	2		3	138	143
Kentucky	20	10,651		2		72	74
Tennessee	2	1				1	1
California	24	2,605				13	13
Colorado	4	207				2	2
Texas	6	798				8	8
South Dakota	4	252				2	2
Missouri	18	124				1	1
Illinois	39	42				1	1
Arkansas	1	58				2	2
Wyoming	1	2				2	2
Indian and Oklahoma Territories	5	15				3	3
Total	2,329	627,047	56	95	348	6,723	7,222

There was an increase of 182 companies and individuals reporting and a decrease of 881 in the number of establishments supplied in 1903, as compared with 1902. A large proportion of the decrease is accounted for by the decreasing pressure of the natural-gas fields in Indiana. 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 the domestic trade, for which natural gas is so eminently fitted and from which nearly all of their revenue is derived. There were 627,047 domestic customers supplied in 1903. It is estimated that not less than 4,000,000 individuals are supplied with light and fuel by natural gas, and that not less than 4,500,000 people receive the benefit of its use as an illuminant.

RECORDS OF WELLS AND LENGTH OF PIPE LINES, BY STATES.

In the following table will be found enumerated by States the number of companies and individuals reporting, the number of the productive natural-gas wells up to the close of December 31, 1902, the productive wells drilled during 1903, the wells abandoned in 1903, those producing at the close of 1903, the nonproductive natural-gas wells drilled during 1903, and the number of feet of wrought iron and steel pipe of all sizes greater than 2 inches in diameter in use at the close of 1903:

Record of wells and amount of pipe line, as reported by 2,329 persons, firms, and corporations in 1903, by States.

State.	Companies or individuals reporting.	Wells.					Total pipe laid to Dec. 31, 1903.	
		Producing, Dec. 31, 1902.	Producing, drilled in 1903.	Abandoned in 1903.	Producing, Dec. 31, 1903.	Nonproducing holes drilled in 1903.	Feet.	Miles.
Pennsylvania	414	5,444	699	228	5,915	126	53,886,301	10,205.74
Ohio	515	1,343	290	110	1,523	62	27,876,583	5,279.66
Indiana	924	5,876	895	1,257	5,514	242	34,838,063	6,598.01
West Virginia	88	903	242	46	1,099	43	18,224,176	3,451.55
New York	144	652	75	20	707	11	7,413,194	1,404.01
Kansas	120	404	295	33	666	66	5,598,720	1,060.34
Kentucky	20	123	....	....	123	3	747,385	141.55
Tennessee	2	2	....	....	2	....	900	.17
California	24	33	5	....	38	....	347,668	65.85
Colorado	4	2	3	2	[a]3	....	75,760	14.35
Texas	6	18	2	2	[a]18	3	149,336	28.28
South Dakota	4	5	....	....	5	....	26,950	5.10
Missouri	18	17	7	2	22	4	38,015	7.20
Illinois	39	33	11	1	43	5	45,618	8.64
Arkansas	1	2	....	....	2	....	60,000	11.36
Wyoming	1	....	2	....	2	....	500	.09
Indian and Oklahoma Territories	5	5	3	1	7	1	4,700	.89
Total	2,329	14,862	2,529	1,702	[b]15,689	566	149,338,869	28,282.71

[a] Gas is produced from oil wells not included in this table.
[b] Includes 199 wells not utilized in 1903.

NATURAL-GAS INDUSTRY IN INDIVIDUAL STATES.

PENNSYLVANIA.

The large increase in the value of the production of natural gas in Pennsylvania in 1903 is remarkable when it is remembered that Pennsylvania is the oldest State producing natural gas in any large quantity. The supply has been derived from the deeply buried sands in Greene and Washington counties in the southwestern portion of the State, and from the counties of Armstrong and Clarion where deeper producing sands have been developed during 1902 and 1903. Several small pools were secured in Potter County. The productive areas are found in lines of elevated strata extending in a general northeast and southwest direction. There is a general dip of about 17½ feet to the mile from the New York State line to the southwestern corner of Pennsylvania, where Greene County joins West Virginia. The conditions necessary for accumulating and storing natural gas in the sandstone reservoirs deeply buried under impervious clay and shale are remarkably well developed over a large portion of western Pennsylvania.

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.

During 1903 a well was drilled in Clinton County, on the Susquehanna River, near Hyner Station, which developed considerable natural gas at a depth of about 2,000 feet. This well was located upon a prominent anticlinal, from which the rocks dip to both the north and the south at the rate of about 200 feet to the mile. The shut-in or rock pressure showed 480 pounds to the square inch and a considerable open flow. A second well was drilled not far from the first, which at 1,222 feet is said to have found a reservoir which, when first opened, gave a pressure of 2 pounds in the open end of a 2-inch pipe.

Value of natural gas produced in Pennsylvania, 1885–1903.

Year.	Value.	Year.	Value.
1885	$4,500,000	1895	$5,852,000
1886	9,000,000	1896	5,528,610
1887	13,749,500	1897	6,242,543
1888	19,282,375	1898	6,806,742
1889	11,593,989	1899	8,337,219
1890	9,551,025	1900	10,215,412
1891	7,834,016	1901	12,688,161
1892	7,376,281	1902	14,352,183
1893	6,488,000	1903	16,182,834
1894	6,279,000		

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, 1902, and 1903.

Record of natural-gas industry in Pennsylvania, 1900–1903.

	1900.	1901.	1902.	1903.
Amount received for sale of gas or value of gas consumed	$9,812,615	$11,785,996	$13,942,783	$16,060,196
Value of natural gas produced	$10,215,412	$12,688,161	$14,352,183	$16,182,834
Value of coal and wood displaced	$9,789,065	$11,892,070	$17,912,629	$20,075,245
Domestic consumers supplied	[a] 229,730	[a] 326,912	185,678	214,432
Iron and steel works supplied	55	82	99	96
Glass works supplied	80	80	124	122
Other establishments supplied	1,161	1,581	2,225	2,616
Total establishments supplied	1,296	1,743	2,448	2,834
Total wells producing Jan. 1	3,407	3,776	4,529	5,444
Total productive wells drilled	513	660	775	699
Total wells abandoned	210	239	203	228
Total wells producing Dec. 31	3,710	4,197	5,101	[b] 5,915
Total dry holes drilled	142	143	232	126
Total feet of pipe laid to Dec. 31	43,865,000	47,913,618	48,863,621	53,886,301
Number establishments reporting	266	296	379	414

[a] Number domestic fires supplied.

[b] Includes 23 wells not used in 1903.

INDIANA.

The value of the natural gas produced in Indiana in 1903 showed a decline of $982,364. This State, in view of the falling pressure in the original rock, has for several years maintained the value of its production in a remarkable manner. The continued decline in the rock pressure is reported in all of the fields in this State, but especially in the older ones and in those that are located near where wells are drilling and are producing petroleum.

Indiana has produced a much larger quantity of natural gas than it has been credited with, as the rates are low and the amount paid is based on the quantity that will pass through an orifice of a certain size instead of on the number of cubic feet that pass through a meter. The combined value of natural gas and petroleum in 1903, amounting to $16,572,491, places Indiana fourth in the rank among the States.

An immense quantity of natural gas has been consumed in Indiana without results, and many wells were allowed to discharge their volume into the air, before a special law was enacted that required the shutting of the wells that flowed large volumes of natural gas with the production of petroleum. The general results of this law, although evaded in numerous cases, were beneficial. The original rock pressure has now declined to such an extent that many cities, villages, and manufacturing plants have been forced to abandon natural gas as a source of heat and to substitute other fuel.

Near the southern portion of the State at Petersburg a single well has for several years supplied that town, and during 1903 an additional well was drilled which gave a considerable volume of natural gas. A number of wells near Princeton have been drilled for petroleum, several of which have developed considerable flows of natural gas.

In the following table will be found a statement of the value of the natural gas produced in Indiana from 1886 to 1903:

Value of natural gas produced in Indiana, 1886–1903.

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	1903	6,098,364

Record of natural-gas industry in Indiana, 1900–1903.

	1900.	1901.	1902.	1903.
Amount received for sale of gas or value of gas consumed	$6,412,307	$6,276,119	$6,710,080	$5,915,367
Value of natural gas produced	$7,254,539	$6,954,566	$7,081,344	$6,098,364
Value of coal and wood displaced	$11,862,768	$10,669,402	$10,066,248	$8,281,515
Domestic consumers supplied	a 181,751	a 153,869	101,481	90,118
Iron and steel works supplied	15	11	20	23
Glass works supplied	101	111	141	130
Other establishments supplied	2,635	2,448	3,121	867
Total establishments supplied	2,751	2,570	3,282	b 1,020
Total wells producing Jan. 1	4,333	4,287	5,371	5,876
Total productive wells drilled	861	985	1,331	895
Total wells abandoned	648	700	882	1,257
Total wells producing Dec. 31	4,546	4,572	5,820	c 5,514
Total dry holes drilled	156	208	205	242
Total feet of pipe laid to Dec. 31	33,958,001	31,241,320	36,121,980	34,838,068
Number of establishments reporting	670	656	929	924

a Number domestic fires supplied.
b In explanation of the decreased number of establishments, it is well to say that about 2,000, which were being supplied at the beginning of 1903, were shut off before the close of the year, and these have been omitted in making up the table.
c Includes 7 wells not used in 1903.

WEST VIRGINIA.

The value of the natural gas produced in this State is increasing at a rapid rate, and in 1903 West Virginia ranked next to Pennsylvania. The deeply buried sands of Lewis, Harrison, and Wetzel counties have responded in a most remarkable manner when pierced by the drill. The counties of Monongalia, Marion, and Calhoun have also furnished wells of large outputs from the Big Injun, Gordon, Gordon Stray, Fourth, Fifth, and Bayard sands. The rock pressure is often from 800 to 1,250 pounds per square inch; the depth of the wells ranges from 2,700 to 3,200 feet, and the volume of gas amounts to from 5,000,000 to 30,000,000 cubic feet open discharge in twenty-four hours. The counties of Tyler, Ritchie, Doddridge, Marshall, Wood, Pleasants, Wirt, Roane, Boone, Mingo, Kanawha, Logan, and Gilmer have also produced wells of greater or less output.

During the year 1903 several new pipe lines of from 16 to 20 inches in diameter were constructed, which led out of this State into Ohio and Pennsylvania, and which enabled those States to show an increase in the value of the natural gas consumed. The main supply comes from the Big Injun and the Venango groups of sandstones, which are deeply buried in West Virginia to the west of the last prominent uplift of the Appalachian chain of mountains. On one of the declining anticlinals of this chain to the southwest many of the largest producers in southern Harrison County and in Lewis County have been secured. To the northwest of this line, however, where the folding is more gentle and extends in anticlinals to the northwest, the largest quantity of the natural gas so far developed has been obtained. In numerous instances it is found in higher portions of the strata, which contain the petroleum lower down the flank of the same anticlinal.

There are instances in which these sands in the same well are largely productive of natural gas, and in which the greater pressure of the lowest sand has filled up and packed those above it until the pressure of all was equalized.

The value of the natural gas produced in West Virginia in 1903 was $6,882,359, an increase of $1,492,178, nearly 28 per cent over 1902. The value of the natural gas sold within the State in 1903 was $3,125,061, which shows that only 45.5 per cent of the total production was consumed within the State and that 54.5 per cent was exported. The total number of wells drilled in this State in 1903 was 285, of which 43 were dry holes and 242 were productive wells. At the close of 1903 there were 1,099 productive wells, and of this number 10 were shut in or not in use. There were 3,451 miles of natural gas pipe in use, varying in size from 2 inches up to 20 inches in diameter.

The value of the natural gas produced in West Virginia from 1889 to 1903 is shown in the following table:

Value of natural gas produced in West Virginia, 1889–1903.

Year.	Value.	Year.	Value.
1889	$12,000	1897	$912,528
1890	5,400	1898	1,334,023
1891	35,000	1899	2,335,864
1892	500	1900	2,959,032
1893	123,000	1901	3,954,472
1894	395,000	1902	5,390,181
1895	100,000	1903	6,882,359
1896	640,000		

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 from 1900 to 1903, inclusive. All of the individual items show an increase in 1903 over 1902, as they do also in 1902 over 1901.

Record of natural-gas industry in West Virginia, 1900–1903.

	1900.	1901.	1902.	1903.
Amount received from sale of gas, or value of gas consumed	$1,530,378	$2,244,756	$2,473,174	$3,125,061
Value of natural gas produced	$2,959,032	$3,954,472	$5,390,181	$6,882,359
Value of other fuel displaced	$1,712,462	$2,415,360	$2,994,777	$4,375,000
Domestic consumers supplied	a 45,943	a 55,808	29,357	36,179
Iron and steel works supplied	2	2	11	9
Glass works supplied	14	13	31	25
Other establishments supplied	168	251	835	1,088
Total establishments supplied	184	266	877	1,122
Total wells producing Jan. 1	328	418	794	903
Total productive wells drilled	129	177	142	242
Total wells abandoned	37	51	51	46
Total wells producing Dec. 31	420	544	885	b 1,099
Total dry holes drilled	6	8	37	43
Total feet of pipe laid to Dec. 31	10,185,093	11,852,803	14,548,395	18,224,176
Number establishments reporting	34	44	79	88

a Number of domestic fires supplied. b Includes 10 wells not used in 1903.

OHIO.

There are three horizons in this State, widely separated in the geological scale and in geographic position, which furnish natural gas. The first known natural-gas deposits were in Noble and Washington counties, where the sandstones of the Carboniferous period, especially those of the Waverley group, have in many cases when drilled into in search of salt brine responded by suddenly blowing out the water in the well and sometimes the light tools also, the result being very often a conflagration by which the surrounding structures were destroyed. Since the first well was drilled in southeastern Ohio numerous wells have developed large quantities of natural gas, and although there was not sufficient volume and pressure to supply the large cities of the State, numerous towns, villages, pumping stations, and drilling and pumping wells have been supplied with fuel over a large portion of the area extending from Columbiana County on the north to Washington County on the south.

Just east of the central portion of the State, not far from the city of Lancaster, a well drilled in 1887 developed a large flow of gas from the Clinton limestone, which at that time was a new productive horizon. This field did not produce natural gas to any very large extent, although it furnished enough for it to be piped to Columbus until 1889, when there was a very rapid development and extension to the south in the vicinity of Sugargrove.

For the last three years this field has been largely drawn upon, and the original rock pressure of nearly 800 pounds to the square inch has been decreased in some localities to less than 200 pounds.

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 in 1902 inside of the area named, only 4 were dry holes. The rock pressure is 750 to 800 pounds to the square inch. The average flow is about 4,000,000 cubic feet per twenty-four hours. One well started at the rate of 14,000,000 cubic feet, but fell off to about 9,000,000 cubic feet. The wells are from 2,150 to 2,200 feet in depth. The area of this field, so far as developed, is much larger than the original Lancaster or Sugargrove field, and promises to produce large quantities of high-pressure natural gas.

During 1902 and 1903 this new pool has been connected with Columbus by two pipe lines, and it is now connected also with a number of towns and villages that were formally supplied by the original Sugargrove pool.

Indications seem to point to the probable connecting of the Knox and the Lancaster pools. The natural gas obtained from this portion of Ohio has resulted in increased revenue, and has arrested a downward tendency in the natural-gas production of the State.

The Trenton rock pools in the northwestern part of the State originally covered an area of about 500 square miles, with an average pressure of about 425 pounds to the square inch. At the present time there is scarcely any pressure over a great portion of this field, and probably less than 100 pounds at any locality. A large quantity of the original natural gas contained in this portion of the State was wasted to advance wild speculation in real estate, and partly because of a mistaken idea that the supply was inexhaustible. Certain portions of the Trenton limestone in this section of Ohio have an open cellular structure, and many of the original wells showed a very great volume of gas, since as much as 24,000,000 cubic feet in twenty-four hours have been known to be discharged from some of the best wells, although at the present time and for several years past the field has become almost exhausted.

There is also a small field in the extreme northeastern part of the State, in Ashtabula County, in which natural gas is found in the Corniferous limestone; and on the south shore of Lake Erie, from Cleveland to Lorain, there are a number of small wells which furnish enough natural gas to supply from one to three or four families.

During the year 1903 West Virginia furnished an increased quantity of natural gas to the cities of northeastern and northwestern Ohio, Toledo being partly supplied with gas from West Virginia; Pennsylvania furnished a considerable quantity of gas to Youngstown and several near-by villages; Kentucky furnished gas to Ironton, and Indiana furnished a decreased supply to several towns on the western borders of the State.

The value of the natural gas produced in Ohio in 1903 was $4,479,-040, which is almost double the value of natural gas produced in 1902. On the other hand, the value of the natural gas consumed in Ohio, which includes that produced within the State and that obtained from West Virginia, Pennsylvania, Kentucky, and Indiana, was $7,200,867, or $2,721,827 more than the State production. Of this excess West Virginia furnished 85 per cent.

The combined value of natural gas and petroleum produced in Ohio in 1903 was $30,713,561, the State ranking second, next to Pennsylvania, both in 1902 and 1903. In 1902 the combined value was $23,112,817, a gain of $7,600,744, or nearly 33 per cent, in favor of 1903. The value of coal, wood, and other fuel displaced in Ohio by natural gas in 1903 was $8,155,570.

The value of the natural gas produced in Ohio from 1885 to 1903 is shown in the following table:

Value of natural gas produced in Ohio, 1885–1903.

Year.	Value.	Year.	Value.
1885	$100,000	1895	$1,255,700
1886	400,000	1896	1,172,400
1887	1,000,000	1897	1,171,777
1888	1,500,000	1898	1,488,308
1889	5,215,669	1899	1,866,271
1890	4,684,300	1900	2,178,234
1891	3,076,325	1901	2,147,215
1892	2,136,000	1902	2,355,458
1893	1,510,000	1903	4,479,040
1894	1,276,100		

Record of natural-gas industry in Ohio, 1900, 1901, 1902, and 1903.

	1900.	1901.	1902.	1903.
Amount received for sale of gas or value of gas consumed	$3,823,209	$4,119,059	$4,785,766	$7,200,867
Value of natural gas produced	$2,178,234	$2,147,215	$2,355,458	$4,479,040
Value of coal and wood displaced	$3,565,142	$4,448,584	$5,351,878	$8,155,570
Domestic consumers supplied	[a] 135,743	[a] 149,709	120,127	197,710
Iron and steel works supplied	10	6	17	19
Glass works supplied	10	13	56	63
Other establishments supplied	1,072	930	713	1,704
Total establishments supplied	1,092	949	786	1,786
Total wells producing Jan. 1	853	885	1,099	1,343
Total productive wells drilled	97	113	266	290
Total wells abandoned	60	48	75	110
Total wells producing Dec. 31	890	950	1,290	[b] 1,523
Total dry holes drilled	19	35	40	62
Total feet of pipe laid to Dec. 31	15,030,304	15,199,295	20,093,670	27,876,563
Number of establishments reporting	231	305	451	515

[a] Number domestic fires supplied.

[b] Includes 18 wells shut in in 1903.

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 familes 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. For the last three years the value of the output of natural gas in New York has increased, the production for 1903 being valued at $493,686, an increase of $147,215 over that of 1902. The value of the natural gas consumed in the State in 1903 was $1,944,667, an increase of $220,958 over the consumption in 1902.

There is also some natural gas produced in Canada, and consumed at Buffalo, N. Y., but it is not included in this statement of production and value.

The value of natural gas produced in New York from 1885 to 1903, inclusive, is given in the following table:

Value of natural gas produced in New York, 1885–1903.

Year.	Value.	Year.	Value.
1885	$196,000	1895	$241,530
1886	210,000	1896	a 256,000
1887	333,000	1897	200,076
1888	332,500	1898	229,078
1889	530,026	1899	294,593
1890	552,000	1900	335,367
1891	280,000	1901	293,232
1892	216,000	1902	346,471
1893	210,000	1903	493,686
1894	249,000		

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, 1900, 1901, 1902, and 1903.

	1900.	1901.	1902.	1903.
Amount received for sale of gas or value of gas consumed	$1,456,286	$1,694,925	$1,723,709	$1,944,667
Value of natural gas produced	$335,367	$293,232	$346,471	$498,686
Value of coal and wood displaced	$1,387,258	$1,655,942	$1,771,077	$1,992,726
Domestic consumers supplied	a 89,837	a 95,161	50,586	57,985
Iron and steel works supplied	0	0	1	....
Glass works supplied	4	2	8	5
Other establishments supplied	184	96	206	203
Total establishments supplied	188	98	215	206
Total wells producing Jan. 1	487	585	588	652
Total productive wells drilled	57	58	69	75
Total wells abandoned	11	8	14	20
Total wells producing Dec. 31	533	580	638	b 707
Total dry holes drilled	11	14	8	11
Total feet of pipe laid to Dec. 31	5,772,796	5,785,088	5,894,517	7,418,194
Number of establishments reporting	89	114	116	144

a Number of domestic fires supplied.

b Includes 6 wells not used in 1903.

KANSAS.

This State has made remarkable progress during 1903, as the active search for petroleum has developed a number of natural-gas reservoirs that were formerly unsuspected.

The present development begins at Paola, in central-eastern Kansas, thence extending in a general southwesterly direction clear across the State into Indian and Oklahoma Territories. There are a series of natural gas producing districts of greater or less area. The counties that have productive areas are Miami, Allen, Neosho, Crawford, Wilson, Montgomery, Chautauqua, and Labette. The principal towns now supplied with natural gas are Paola, Osawatomie, Greely, Iola, Gas City, Laharpe, Humboldt, Chanute, Erie, Benedict, Fredonia, Thayer, Cherryvale, Independence, Coffeyville, and Chetopa, besides many villages and individuals scattered over this great area. Although some of the older districts have begun to show a decrease in pressure, the additional area lately developed indicates that this portion of the State will in the future supply a number of the larger cities within its border and also those nearest in Missouri.

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 drilled.

The value of the natural gas produced in Kansas in 1903 was $1,123,849, as compared with $824,431 in 1902, a gain of $299,418. The value of the fuel displaced was $1,676,351. There were nearly 16,000 domestic consumers and 143 manufactories supplied, which includes iron and steel works, zinc smelters, and glass and brick works. The total number of wells producing at the beginning of 1903 was 404 and 295 were drilled during the year, making a total of 666 natural-gas wells drilled at the close of 1903. Of this number 124 were not in use. There were 33 wells abandoned and 66 dry holes drilled during the year. There were 1,060 miles of main pipe line from 2 inches up to 12 inches in diameter in use at the close of 1903. The value of the petroleum produced in Kansas in 1903 was $988,220, which, added to the value of the natural gas, gives a total of $2,112,069.

The value of the natural gas produced in Kansas from 1889 to 1903 has been as follows:

Value of natural gas produced in Kansas, 1889–1903.

Year.	Value.	Year.	Value.
1889	$15,873	1897	$105,700
1890	12,000	1898	174,640
1891	5,500	1899	332,592
1892	40,795	1900	356,900
1893	50,000	1901	659,173
1894	86,600	1902	824,431
1895	112,400	1903	1,123,849
1896	124,750		

The following table gives in detail the record for natural gas in Kansas during 1901, 1902, and 1903:

Record of natural-gas industry in Kansas, 1901, 1902, and 1903.

	1901.	1902.	1903.
Amount received for sale of gas or value of gas consumed	$659,173	$824,431	$1,123,849
Value of natural gas produced	$659,173	$824,431	$1,123,849
Value of coal and wood displaced	$995,350	$1,175,349	$1,676,351
Domestic consumers supplied	10,227	13,488	15,918
Iron and steel works supplied	0	1	2
Zinc smelters supplied	8	9	11
Glass works supplied	0	3	3
Brick works supplied	12	14	14
Other establishments supplied	52	64	113
Total establishments supplied	72	91	143
Total wells producing Jan. 1	213	299	404
Total productive wells drilled	71	144	295
Total wells abandoned	28	24	33
Total wells producing Dec. 31	256	419	[a] 666
Total dry holes drilled	35	63	66
Total feet pipe laid to Dec. 31	2,425,410	5,034,791	5,598,720
Number of establishments reporting	48	80	120

[a] Includes 124 wells which were not in use in 1903.

INDIAN AND OKLAHOMA TERRITORIES.

A well was brought in on November 26, 1903, at Pawhuska, Okla., the product of which is now (1904) being supplied to consumers in the town of Pawhuska. Other wells are being drilled.

At Lawton, Comanche County, gas from a well drilled in 1903 is being used to drill well No. 2. The pressure of the gas seems to be as strong as when the well was drilled.

While prospecting for oil near Newkirk, Kay County, a little gas was struck in the fall of 1903 and torches were burned awhile in the streets of Newkirk, but the well was finally lost through water.

At Redfork, Ind.T., some gas is produced and used for fuel purposes.

MISSOURI.

The gas produced in Missouri comes principally from wells located at Belton, Cass County, and Kansas City, Jackson County. The gas is found at shallow depths. There are also a few wells producing gas in Bates County, the product of which is used by the owners of the wells for domestic purposes, none being sold.

ARKANSAS.

During the year 1903 a number of consumers in the towns of Mansfield and Huntington were supplied with gas from two wells located in Sebastian County. The pressure seems to be stronger than it was a year ago. The gas is found at a depth of 865 to 1,040 feet in dry sand; is clean and almost odorless.

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.

There was a small quantity of natural gas produced in Tennessee that was consumed in Kentucky, and also some produced in West Virginia was consumed in Kentucky.

The value of the natural gas produced, including the small quantity produced in West Virginia and Tennessee, was $390,601, a gain of $24,945 over that of 1902. The combined value of natural gas and petroleum was $876,684.

The value of the natural gas produced in Kentucky from 1889 to 1903 is shown in the following table:

Value of natural gas produced in Kentucky, 1889–1903.

Year.	Value.	Year.	Value.
1889	$2,580	1897	$90,000
1890	30,000	1898	103,133
1891	38,993	1899	125,745
1892	43,175	1900	286,243
1893	68,500	1901	270,871
1894	89,200	1902	a 365,656
1895	98,700	1903	b 390,601
1896	99,000		

a Includes some gas produced in West Virginia but consumed in Kentucky; also $45 worth of gas produced in Tennessee.

b Includes some gas produced in West Virginia but consumed in Kentucky; also $300 worth of gas produced in Tennessee.

TENNESSEE.

No natural gas is produced commercially in this State, so far as is known. There are three wells, one located in Warren County, drilled in 1866, another in Franklin County, the product of which is used for domestic purposes and to drive a 6-horsepower engine, and a third in Fentress County, near the Kentucky line, known as the Beatty gas well. See footnotes under table of value of natural gas in Kentucky.

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 1903 was valued as follows:

Value of natural gas produced in Illinois, 1889–1903.

Year.	Value.	Year.	Value.
1889	$10,615	1897	$6,000
1890	6,000	1898	2,498
1891	6,000	1899	2,067
1892	12,988	1900	1,700
1893	14,000	1901	1,825
1894	15,000	1902	1,844
1895	7,500	1903	3,310
1896	6,375		

ALABAMA.

Two natural gas wells were recently drilled near Hazel Green, Madison County, Ala., which are producing a small quantity of natural gas. Well No. 1, which is 625 feet deep, came in on March 21, 1903, and showed a closed pressure of 55 pounds; well No. 2, which is 375 feet deep and was drilled in during March of 1904, is reported to be stronger than No. 1.

CALIFORNIA.

Although there are numerous small gas wells in this State, by far the greatest production comes from wells at the city at Stockton, in the great 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 value of the natural gas produced in California from 1889 to 1903 is shown in the following table:

Value of natural gas produced in California, 1889–1903.

Year.	Value.	Year.	Value.
1889	$12,680	1897	$50,000
1890	33,000	1898	65,337
1891	30,000	1899	86,891
1892	55,000	1900	79,063
1893	62,000	1901	67,602
1894	60,350	1902	a 120,648
1895	55,000	1903	b 104,521
1896	55,682		

a Includes $32,188 worth of gas produced from oil wells and consumed in oil operations.
b Includes $34,452 worth of gas produced from oil wells and consumed in oil operations.

TEXAS.

The value of the natural gas produced in Texas in 1903 was $21,351, as compared with $14,953 in 1902 and with $18,577 in 1901. Nearly all the gas consumed in this State is taken from wells near Corsicana. Some natural gas was consumed from the wells at Spindle Top and Sour Lake.

Some wonderful pockets of high-pressure gas have been developed in the Spindle Top and Sour Lake fields, which blew up bowlders and sand mixed with water and traces of petroleum. When the pressure was confined it developed 250 to 300 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 Bryan's 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 1903 has been as follows:

Value of natural gas produced in South Dakota, 1899–1903.

Year.	Value.	Year.	Value.
1899	$3,500	1902	$10,280
1900	9,817	1903	10,775
1901	7,255		

UTAH.

No natural gas has been produced in this State for five years. The wells, 12 miles north of Salt Lake City, have become choked by the decomposition of the slate forming the walls of the gas wells.

WYOMING.

Two very fair gas wells were drilled in at Douglas, Wyo., in 1903, one on September 5, the other on October 24. The product is being used for fuel and light for drilling purposes.

COLORADO.

In 1903 natural gas was discovered in a well about three miles from Boulder and the product is supplied to domestic consumers in Boulder for both illuminating and fuel purposes. In the Florence oil field some gas is produced from the oil wells and to a small extent is used for domestic purposes and also under boilers in the field.

CANADA.

There was an increase in the value of natural gas produced in Canada the during 1903, due chiefly to the increased production in the Welland field, in which several extensions have been recently developed. The Essex County field continues to decrease in output, and it has not delivered any natural gas to Detroit since the fall of 1901. The Welland field furnishes a considerable quantity to Buffalo.

Statistics of natural-gas production in the Province of Ontario, Canada, 1893–1903.

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	183	99	204,179	53,130
1895	123	248	92	282,986	73,328
1896	141	287	87	276,710	47,527
1897	140	297	84	308,448	42,338
1898	142	315	85	301,599	31,457
1899	150	341	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
1903	210	312	138	196,535	79,945

NATURAL GAS IN WESTERN CANADA.

There is a growing production of natural gas near Medicine Hat, on the Canadian Pacific Railroad, in the western portion of the province of Assiniboia, on the eastern foothills of the Rocky Mountains. The first well drilled in 1891 in search of coal developed a flow of natural gas. In 1899 Mr. J. C. Colter drilled a well which supplied several families with light and fuel. This was followed up by the drilling of four wells in the interest of the town. Gas was found in all of them, and was piped throughout the town and sold at 20 cents per 1,000 cubic feet. Afterwards it was decided to drill deeper, and a well at 1,000 feet found a sand rock from which a flow of about 1,000,000 cubic feet was secured, the shut-in pressure being 500 pounds to the square inch.

Indications from surface examinations show a large area of prospective natural-gas territory in this section.

ASPHALTUM AND BITUMINOUS ROCK.

By Edmund Otis Hovey.

INTRODUCTION.

In commerce the term "asphaltum" is generally used to indicate any or all of the varieties of hydrocarbons which are included under the mineralogical names of asphaltum, as elaterite, wurtzilite, albertite, grahamite, uintaite, gilsonite, and some other less well-known compounds which exist in nature in all conditions from the viscid to the solid. In this report no distinction is made between the various kinds of asphaltic minerals, but all are included under the general term. Opinion is divided as to the propriety of applying the term "asphalt" to the residuum obtained by the distillation of some of the crude petroleums. The industry of producing an asphaltic roofing and paving material from the destructive distillation of the California oils has grown to large proportions, as will be seen by consulting the table on page 7. In the general table on page 7, asphalt of this character is entered under the heading "By-product from oil," as was done in the report for 1902.

The term "bituminous rock" is used in the table on page 6 for all the asphalt-bearing sandstones and limestones which are used without previous refining in the making of street pavements. In practice the material is mixed with other ingredients, as may be thought best at the place of use. The bituminous sandstone reported is quarried in California, Kentucky, and Indian Territory. For detailed descriptions of the asphalt and bituminous rock deposits of the United States, readers are referred to the article thereon by Mr. George H. Eldridge, in the Twenty-second Annual Report of the United States Geological Survey.[a]

[a] Eldridge, George H., The asphalt and bituminous rock deposits of the United States: Twenty-second Ann. Rept. U. S. Geol. Survey, pt. 1, 1901, pp. 219-452.

PRODUCTION.

The following table shows the annual production of asphaltum and bituminous rock in the United States from 1882 to 1903, inclusive:

Production of asphaltum and bituminous rock, 1882–1903.

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	105,458	765,048
1892	87,680	445,375	1903	101,255	1,005,446

As will be seen from this table, the production of asphalt and bituminous rock in 1903 was not quite so large as in 1902, but the value of the product increased by $240,398, or over 31.4 per cent. The large increase in value was due to the expansion of the industry of manufacturing "asphaltum" as a by-product in the refining of California crude oil. Many of the plants and mines which were in operation upon bituminous rock and hard or gum asphaltum in 1902 reported no production in 1903.

From the following table, which classifies the production according to varieties, it will be seen that the production of bituminous sandstone decreased from 57,837 short tons ($156,993) in 1902 to 38,633 short tons ($118,001) in 1903. The production of bituminous limestone increased from 1,869 short tons in 1902 ($7,817) to 2,520 short tons ($8,800) in 1903. Mastic, which has been reported separately for several years, is given at 961 short tons ($11,532), most of which was produced from bituminous sandstone quarried in Kentucky. The production of hard and refined or gum asphalt, which includes gilsonite, shows a decrease from 22,321 short tons in 1902 to 12,896 short tons in 1903; but the reported value increased from $264,817 in 1902 to $343,799 in 1903. No production of liquid asphaltum or maltha was reported from California, but 58 short tons, valued at $1,150, were reported from Texas. The amount of asphaltic material produced by the destructive distillation of petroleum increased from 20,826 short tons ($303,249) in 1902 to 46,187 short tons ($522,164) in 1903; but the average value per ton decreased from $14.56 to $11.31. Prior to 1902 the asphaltum produced as a by-product from petroleum was included under the heading "Hard and refined, or gum."

Both quantity and value as given in the following two tables, which distribute the production by varieties and by States, are for the product in the condition in which it was first sold.

Varieties of asphaltum, etc., produced annually, 1897–1903.

Variety.	1897.		1898.		1899.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Bituminous sandstone	48,801	$158,914	48,624	$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	18,178	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.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Bituminous sandstone	38,334	$119,779	34,248	$138,601	57,837	$156,993	38,633	$118,001
Bituminous limestone [a]	2,434	11,822	6,970	33,375	2,869	19,817	2,520	8,800
Mastic	....	....	....	....	....	....	961	11,532
Hard and refined, or gum [b]	12,367	256,793	19,316	333,509	22,321	264,817	12,896	343,799
Liquid, or maltha	1,254	28,064	2,600	49,850	1,605	20,172	58	1,150
By-product from oil	....	....	....	....	20,826	303,249	46,187	522,164
Total	54,389	415,958	63,134	555,335	105,458	765,048	101,255	1,005,446

[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.

Distribution of production of asphaltum in 1903, by States.

Variety.	California.		Texas.		Utah.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Bituminous sandstone	24,080	$69,862	....	....	....	....
Bituminous limestone	....	....	....	....	....	....
Mastic	11	132	....	....	....	....
Hard and refined, or gum asphalt	6,400	140,000	....	....	5,619	$188,357
Liquid asphalt, or maltha	....	....	58	$1,150	....	....
By-product from oil	44,087	492,764	2,100	29,400	....	....
Total	74,578	702,758	2,158	30,550	5,619	188,357

Variety.	Kentucky.		Indian Territory.		Arkansas.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Bituminous sandstone	11,628	$38,763	1,710	$3,908	1,215	$5,468
Bituminous limestone	....	....	2,520	8,800	....	....
Mastic	950	11,400	....	....	....	....
Hard and refined, or gum asphalt	....	....	877	15,442	....	....
Liquid asphalt, or maltha	....	....	....	....	....	....
By-product from oil	....	....	....	....	....	....
Total	12,578	50,163	5,107	28,150	1,215	5,468

EXPORTS.

During the year ending June 30, 1903, asphaltum and manufactures of asphaltic material of domestic production to the total value of $104,586 were exported from the United States to other countries. The most important receivers of these products were, in the order named, the Dominion of Canada, Peru, United Kingdom, Brazil, and Argentina. The corresponding exports for the fiscal 1902 amounted to $89,654.

IMPORTS.

More than two-thirds of the asphaltum which is imported into the United States from foreign countries comes from the island of Trinidad off the coast of Venezuela. Other important sources of the material are Venezuela (Bermudez), Italy, and Cuba, and smaller quantities, mostly in the shape of bituminous limestones, are imported from Germany, Turkey in Europe, Mexico, Switzerland, France, Great Britain, Turkey in Asia, and the United States of Colombia.

The following table shows the imports of crude asphaltum by fiscal years from 1867 to 1885; and by calendar years from 1886 to 1903, inclusive:

Crude asphaltum imported for immediate consumption into the United States, 1867–1903.

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	84,065
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	299,380
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	392,779
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	489,570
1884	36,078	145,571	1903 g	181,579	593,346
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.
g Includes 15,357 long tons, "dried or advanced," valued at $83,591.

As will be seen from the following table, the imports from Trinidad increased from 99,592 long tons ($329,819) in the fiscal year ending June 30, 1902, to 129,133 long tons ($367,003) in the fiscal year 1903, and the imports from Venezuela increased from 12,406 long tons in 1902 ($62,028) to 16,445 long tons ($74,874) in 1903. The imports from the British West Indies, which are cited as coming from Trinidad, include 547 tons of manjak from Barbados, the value of which has not been given separately. The imports from Cuba show an increase from 7,252 long tons ($28,497) in 1902 to 9,898 long tons ($48,218) in 1903.

Imports of asphaltum during the fiscal years ending June 30, 1900, 1901, 1902, and 1903, 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
Turkey in Europe						
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
Switzerland						
Total	106,162	363,291	136,440	497,194	119,625	428,871

Country.	1903.	
	Quantity.	Value.
West Indies:	*Long tons.*	
British (mostly Trinidad)	129,133	$367,003
Cuba	9,898	48,218
Italy	18,789	61,284
Venezuela (Bermudez)	16,445	74,874
Germany	1,422	9,974
France	298	1,462
Mexico	621	2,369
Turkey in Asia	67	5,038
Turkey in Europe	638	8,917
Great Britain	136	2,885
United States of Colombia	3	106
Switzerland	442	3,735
Total	172,892	585,865

PRODUCTION IN OTHER COUNTRIES.

TRINIDAD.

The exports of asphalt from the island of Trinidad are given in the following tables, which have been furnished through the courtesy of the New Trinidad Lake Asphalt Company (Limited).

Eight-ninths of the asphalt exported from the island is obtained from Pitch Lake,[a] which is exploited by the New Trinidad Lake Asphalt Company (Limited), under a lease which does not expire until 1930. Fresh supplies of mineral pitch are flowing constantly into the lake from subterranean sources, but the amount which thus comes in annually is much less than the amount dug from the deposit. Not less than 2,050,000 long tons of asphalt have been removed from this deposit, the annual exploitation having risen from 25,517 long tons in 1881 to 165,532 long tons in 1903.

Exports of Pitch Lake asphaltum from Trinidad, 1881–1903.

[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.	
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	109,943
1898	46,089	1,692	48,423	15,708	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
1903	118,661	3,536	123,582	27,025	13,921	40,946	1,000	3	1,004	165,532

[a] For a particularly full account of this remarkable deposit see The Pitch Lake of Trinidad, by S. F. Peckham, in the American Journal of Science, July, 1895, page 33.
[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, 1886–1903.

[In tons of 2,240 pounds.]

Year.	To United States.			To Europe.			To other countries.			Grand total of exports in crude equivalent.
	Crude.	Épuré.	Total equivalent in crude.	Crude.	Épuré.	Total equivalent in crude.	Crude.	Épuré.	Total equivalent in crude.	
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	20,514	139	....	139	40	....	b 40	20,693
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	1,985	3,824	....	....	....	15,873
1897	19,243	....	19,243	298	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
1903	18,478	....	18,478	2,258	628	3,200	1,347	224	1,686	23,364

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, 1886–1903.

[In tons of 2,240 pounds.]

Year.	To United States.			To Europe.			To other countries.			Grand total.
	Lake.	Land.	Total.	Lake.	Land.	Total.	Lake.	Land.	Total.	
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	20,514	73,024	24,937	139	25,076	901	40	941	99,041
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	96,819
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
1903	123,582	23,364	146,946	40,946	3,200	44,146	1,004	1,686	2,690	193,782

a The dried and "épuré" in 1899 and 1900 are not reduced to crude equivalents.

BARBADOS.

The annual production of Barbados manjak, or glancepitch, has been decreasing for at least seven years, with the exception that 1900 showed a slight increase over 1899. Nine mines were in operation on the island during 1902, three of which were worked by the Barbados Manjak Mines (Limited), with a force of from 70 to 100 laborers. S. W. Knoggs, esq., colonial secretary of Barbados, reports that the exports of crude manjak for the last two years have been as follows:[a]

Exports of crude manjak from Barbados in 1902 and 1903.

Year.	To United States.	To Europe.	To other countries.
	Long tons.	*Long tons.*	*Long tons.*
1902	547	302.5	19
1903	382.3	210	58.55

The average export value of manjak in 1901 was a trifle more than £9 per long ton. During recent years the exports of this material from Barbados have been reported as follows: 1897, 1,880 long tons; 1898, 1,160 long tons; 1899, 1,026 long tons; 1900, 1,120 long tons; 1901, 1,043 long tons; 1902, 868.5 long tons; 1903, 650.85 long tons.

Manjak is a very pure form of "land asphaltum," and it is used for the manufacture of Brunswick varnish, the insulation of electric cables, etc.

VENEZUELA.

The exports of asphalt from Bermudez Lake in Venezuela to the United States, which fell off greatly during 1902 on account of litigation between the two American companies leasing the right to work the deposits, regained a portion of their previous importance, the legal troubles between the companies having been settled.

CUBA.

A somewhat detailed account of the asphalt resources of the island of Cuba may be found in the advance extract on "The production of asphaltum and bituminous rock," from Mineral Resources for the year 1902.[b] As may be seen from the tables already given, the industry is rapidly expanding. Five-sixths of the asphalt exported from Cuba during the year ending June 30, 1903, was sent to the United States.

[a] Communicated through the courtesy of Sir Percy Sanderson, K. C. M. G., British consul-general at New York.

[b] The production of asphaltum and bituminous rock: Mineral Resources U. S. for 1902, U. S. Geol. Survey, 1903.

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 1902, inclusive:

Production of asphaltum in principal producing countries, 1890–1902.

Year.	United States.		Trinidad.		Germany.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1890	40,841	$190,416	94,334	$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	347,810	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	99,068
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
1902	a 84,632	461,799	178,230	828,347	97,415	146,470

Year.	France.		Italy.		Spain.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1890	198,984	$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	293,654	383,429	112,115	292,287	4,621	8,632
1901	275,695	372,989	114,761	261,761	4,361	8,137
1902	284,719	390,254	70,619	151,829	6,946	12,356

a 20,826 short tons of asphaltum ($308,249) are excluded from this table of crude production, since they are the by-product of oil refining.

Production of asphaltum in principal producing countries, 1890–1902—Continued.

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	11,55[illegible]
1898	4,152	86,018	13,244	128,176	Nil.
1899	6,276	79,634	25,435	170,300	12,018
1900	3,787	70,603	27,657	....	17,961
1901	3,770	69,164	(a)	....	24,37[illegible]
1902	4,047	67,623	(a)	....	10,060

a Statistics not yet available.

STONE.[a]

INTRODUCTION.

The effort is made in these annual reports to record the significant changes in the stone industry during the year under review. The most precise summary of the general condition of the stone trade as a whole is best shown by the total value of the stone product. The fluctuations of this net result form a valuable barometer as to the general prosperity of the business. A general review of these totals for a succession of years shows a rather phenomenal growth in the use of building stone, but a decrease of this product for the year just passed, and also an increasing production of crushed stone, which has advanced from a small and unimportant industry to one now representing one-fifth of the entire stone output.

In classifying the various kinds of stone many essentially different rocks are, for simplicity of treatment, grouped in the following classes: Granite, bluestone, marble, trap rock, limestone, sandstone, and slate. This classification was explained in detail in the report for 1902.

PRODUCTION.

In making the statements as to the value of the stone the figures 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 cost of shipment. 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 1903 was $67,960,468. The value in 1902 was $64,559,099. This shows a gain in 1903 of $3,401,369. The corresponding gain in 1902 over 1901 when the figures were $55,615,926, was $8,943,173—a larger increase in 1902 than in 1903.

Limestone, not including furnace flux, increased more in value of production than any other kind of stone, the figures for 1903 being

[a] The collection of these statistics and the compilation of the returns have been carried on as in previous years by Miss Altha T. Coons, statistical expert of this office, who has also prepared the entire report on stone tests and analyses.—D. T. DAY.

$26,642,551 and for 1902 $24,959,751, a gain of $1,682,800 for 1903. The value of limestone used for blast-furnace flux, and not included in the above, increased from $5,271,252 in 1902 to $5,423,732 in 1903, a gain of $152,480, making the total gain in the limestone output $1,835,280.

Granite, including trap rock, increased from $18,257,944 in 1902 to $18,436,087 in 1903, or $178,143. The trap rock production increased from $2,181,157 in 1902 to $2,732,294 in 1903, a gain of $551,137. The granite decreased from $16,076,787 in 1902 to $15,703,793 in 1903, a decrease of $372,994.

Sandstone, including bluestone, but not including grindstones and whetstones, increased from $10,601,171 in 1902 to $11,262,259 in 1903, a gain of $661,088. The value of bluestone, included in the above figures, was $1,163,525 in 1902 and $1,779,457 in 1903, a gain of $615,932 for 1903.

The sandstone figures increased from $9,437,646 in 1902 to $9,482,802 in 1903, a gain of $45,156.

The value of the marble increased $318,504, from $5,044,182 in 1902 to $5,362,686 in 1903.

The slate output increased $560,834 in value, from $5,696,051 in 1902 to $6,256,885 in 1903.

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 published by this office.

Value of the different kinds of stone produced in the United States, 1894–1903.

Year.	Granite.	Trap Rock.	Marble.	Slate.	Sandstone.	Bluestone.	Limestone.	Total.
1894....	$10,029,156	....	$3,199,585	$2,790,324	$3,955,847	[a] $900,000	$16,190,118	$37,065,039
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	[c] 14,204,966	36,607,264
1899....	10,343,298	$1,275,041	4,011,681	3,962,733	[b] 4,924,670	815,284	[c] 16,177,164	41,509,871
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] 9,437,646	1,163,525	[c] 24,959,751	64,559,099
1903....	15,703,793	2,732,294	5,362,686	6,256,885	[b] 9,482,802	1,779,457	[c] 26,642,551	67,980,468

[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 the United States in 1902 and 1903, by States:

Value of various kinds of stone produced in 1902 and 1903, by States.

1902.

State.	Granite.	Sandstone.	Slate.	Marble.	Limestone.	Total value.
Alabama		$42,706		(a)	$759,617	$802,323
Arizona	$3,000	107,910				110,910
Arkansas	12,115	85,917	$4,000	(a)	113,163	211,195
California	b 1,137,679	462,328	31,500	$92,298	496,843	2,189,148
Colorado	66,023	366,161			203,700	635,884
Connecticut	b 812,141	128,579		(a)	205,371	1,146,091
Delaware	276,753					276,753
Florida					63,571	63,571
Georgia	803,778	1,250	4,000	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
Iowa		15,061		(a)	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	(a)	453,030	1,344,722
Massachusetts	b 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		(a)	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	b 948,474	406,726	32,000		181,650	1,536,850
New Mexico		12,291		(a)		12,291
New York	b 651,014	c 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	b 661,062	c 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		(a)	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				c 180,561		252,061
Total	b 18,257,944	c 10,601,171	5,696,051	5,044,182	d 30,231,003	e 69,830,351

a Included in other States. b Includes trap rock. c Includes bluestone.
d Includes Alabama, Arkansas, Connecticut, Iowa, Maryland, Montana, New Mexico, and Utah.
e Includes blast-furnace flux.

Value of various kinds of stone produced in 1902 and 1903, by States—Continued.

1903.

State.	Granite.	Sandstone.	Slate.	Marble.	Limestone.	Total value.
Alabama		$42,933		(a)	$719,404	$762,337
Arizona	$3,000	526,875		(a)	1,260	531,135
Arkansas	47,136	61,172	$4,709		242,628	355,645
California	b 1,627,592	762,327	70,000	$78,329	611,126	3,149,374
Colorado	100,791	389,132			218,120	708,043
Connecticut	b 1,101,425	119,417		(a)	154,536	1,149,374
Delaware	369,166					369,166
Florida					64,898	64,898
Georgia	672,947			565,605	73,352	1,311,904
Hawaii						
Idaho	2,750	11,856			18,952	33,558
Illinois		26,293			3,206,271	3,232,564
Indiana		32,651			2,935,274	2,967,925
Indian Territory	4,030				1,450	5,480
Iowa		19,011			635,431	654,442
Kansas		102,128			495,069	597,197
Kentucky		93,742			746,590	840,332
Maine	2,586,765		231,230		793,553	3,611,548
Maryland	837,787	2,170	137,631	83,672	386,226	1,447,486
Massachusetts	b 2,720,066	372,478		154,228	272,471	3,519,243
Michigan		121,350			609,082	730,432
Minnesota	403,906	363,262			676,090	1,443,258
Missouri	150,409	49,402		(a)	2,516,688	2,716,499
Montana	25,993	68,036		(a)	152,694	246,723
Nebraska		1,067			187,718	188,785
Nevada	7,450	2,370			2,400	12,220
New Hampshire	854,513					854,513
New Jersey	b 943,171	364,337	(c)		187,711	1,495,219
New Mexico		7,510			1,000	8,510
New York	549,015	d 1,756,501	145,401	748,160	2,543,756	5,742,833
North Carolina	218,947	600		4,365	600	224,512
Ohio		1,793,379			3,320,672	5,114,051
Oklahoma	5,000	6,500			54,690	66,190
Oregon	118,411	2,912			16,684	138,007
Pennsylvania	b 829,535	d 3,255,073	3,959,906	93,200	5,775,506	13,913,220
Rhode Island	710,291				39,315	749,606
South Carolina	476,863				44,780	521,643
South Dakota		163,067			39,266	202,333
Tennessee		20,649		485,905	555,574	1,062,128
Texas	173,325	114,381			262,053	549,759
Utah	3,803	71,279		3,200	618,900	697,182
Vermont	1,810,179		1,592,652	3,011,505	190,724	6,605,060
Virginia	299,335	4,471	115,356		569,205	988,367
Washington	209,095	47,430		40,117	297,701	594,343
West Virginia		252,204			558,024	810,228
Wisconsin	573,391	142,445			1,256,661	1,972,497
Wyoming		91,849		3,100	12,183	107,132
Other States				e 91,300		91,300
Total	b 18,436,087	d 11,262,259	6,256,885	5,362,686	f 32,006,283	f 73,324,200

a Included in other States.
b Includes trap rock.
c Included in New York.
d Includes bluestone.
e Includes Alabama, Arizona, Connecticut, Missouri, and Montana.
f Includes blast-furnace flux.

The following table is given to show the total values of the stone used for various purposes in 1902 and 1903. 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 1902 and 1903.

1902.

Kind.	Building (rough and dressed).	Monumental (rough and dressed).	Flagstone.	Curbstone.	Paving.	Crushed stone.
Granite	$7,084,832	$3,998,911	$52,880	$823,846	$1,523,776	$3,211,780
Sandstone	6,007,484		1,142,699	672,654	527,617	1,116,449
Limestone	5,563,084		241,688	331,968		7,152,730
Marble	2,184,941	1,942,674				
Total	20,790,341	5,941,585	1,437,267	1,828,468	2,051,393	11,480,959

1903.

Kind.	Building (rough and dressed).	Monumental (rough and dressed).	Flagstone.	Curbstone.	Paving.	Crushed stone.
Granite	$6,192,145	$3,808,417	$91,142	$701,018	$1,954,266	$3,780,487
Sandstone	6,403,969		1,164,156	1,003,528	696,053	827,585
Limestone	4,981,241		166,961	355,167	515,760	8,580,866
Marble	2,218,136	1,958,943				
Total	19,795,491	5,767,360	1,422,259	2,059,713	3,166,079	13,188,938

As will be seen from this table the value of stone used for building decreased—from $20,790,341 in 1902 to $19,795,491 in 1903—a loss of $994,850. In 1902 the increase in value over 1901 was $3,953,960, which was more than the decrease for 1903, and in 1901 the increase over 1900 was $4,440,002.

There was also a decrease to $5,767,360 in the value of the monumental stone quarried in 1903, from $5,941,585 in 1902, a loss of $174,225. In 1902 the increase of this product over 1901 was $1,206,886.

These decreases in the building and monumental stone industries were almost entirely due to labor troubles, builders' strikes, and the consequent small demand and low price for cut stone as compared with cost of production, which prevented large producers from taking contracts calling for cut stone.

The value of the flagstone output remained practically the same as in 1902, there being a slight decrease, from $1,437,267 in 1902 to $1,422,259 in 1903.

The value of the curbstone reported increased from $1,828,468 in 1902 to $2,059,713 in 1903, a gain of $231,245.

Stone for paving increased from $2,051,393 in 1902 to $3,166,079 in 1903, a gain of $1,114,686.

Crushed stone increased from $11,480,959 in 1902 to $13,188,938 in 1903, an increase of $1,707,979.

The following tables show the value of crushed stone in 1902 and 1903 according to the variety of stone, and according, also, to the purpose for which this stone was used:

Value of crushed stone in the United States in 1902 and 1903.

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

1903.

Kind.	Railroad ballast.	Road making.	Concrete.	Total value.
Limestone	$3,105,602	$2,997,547	$2,477,717	$8,580,866
Sandstone	287,988	289,325	250,272	827,585
Granite	750,142	1,896,191	1,134,154	3,780,487
Total	4,143,732	5,183,063	3,862,143	13,188,938

As will be seen from these tables, the value of stone used for concrete increased more than that of stone used for either ballast or road making in 1903 as compared with 1902, the value of stone used for road making decreasing slightly.

In the following tables is shown the total value of the crushed stone produced in the United States in 1902 and 1903, by States:

Value of crushed stone produced in the United States in 1902 and 1903, by States.

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
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

Value of crushed stone produced in the United States in 1902 and 1903, by States—Cont'd.

1903.

State.	Granite.	Limestone.	Sandstone.	Total value.
Alabama		$460		$460
Arizona			$13,125	13,125
Arkansas	$44,136	5,813	13,076	63,025
California	387,228	92,245	80,920	560,393
Colorado	600		37,635	38,235
Connecticut	207,607			207,607
Delaware	83,221			83,221
Florida		3,256		3,256
Georgia	59,762	7,600		67,362
Hawaii				
Illinois		1,382,823		1,382,823
Indiana		332,644	5,000	337,644
Indian Territory		650		650
Iowa		177,484	382	177,866
Kansas		256,228	31,850	288,078
Kentucky		450,320	1,100	451,420
Maine	11,678			11,678
Maryland	220,555	48,464	1,375	270,394
Massachusetts	447,674	50	204,719	652,443
Michigan		145,186	5,500	150,686
Minnesota	22,140	109,040	20,721	151,901
Missouri	42,827	1,041,656	24	1,084,507
Montana			165	165
Nebraska		74,452	30	74,482
New Hampshire	16,407			16,407
New Jersey	811,671	2,408	1,950	816,029
New Mexico			250	250
New York	404,694	1,234,214	29,394	1,668,302
North Carolina	100,432			100,432
Ohio		1,075,866	38,288	1,114,154
Oklahoma		30,000	600	30,600
Oregon	16,500		97	16,597
Pennsylvania	478,200	1,413,770	224,813	2,116,783
Rhode Island	20,628	300		20,928
South Carolina	57,577	850		58,427
South Dakota		19,026	6,000	25,026
Tennessee		108,768	93	108,861
Texas	64,750	58,631	22,300	145,681
Utah				
Vermont	9,541	3,345		12,886
Virginia	110,005	25,743	803	136,551
Washington	13,239	1,950		15,189
West Virginia		148,446	15,202	163,648
Wisconsin	149,415	329,178	1,550	480,143
Wyoming			70,623	70,623
Total	3,780,487	8,580,866	827,585	13,188,938

GRANITE.

The stone classed as granite in this report includes gneiss, mica-schist, lava, andesite, syenite quartz porphyry, trap rock, basalt, and allied igneous rocks. Too small quantities of these allied stones are quarried to make it practicable to tabulate them separately. Trap rock, however, as quarried in California, Connecticut, New York, New Jersey, and Pennsylvania represents a sufficient industry by itself to make it advisable to show the value of this stone separately from the granite. The California trap rock includes considerable basalt, quarried and manufactured mostly into paving blocks.

In 1903 the value of the granite produced in the United States was $18,436,087; in 1902 it was practically the same, $18,257,944, the increase for 1903 being only $178,143. In 1902 the increase in value over 1901 was $2,280,983; in 1901 the increase over 1900 was $3,301,344, and in 1900 the increase over 1899 was $1,057,278. The falling off in 1903 was principally in the Eastern States—Massachusetts, New Hampshire, Maine, and Rhode Island being most noticeably affected. These States find a market for their stone chiefly in the large cities, and the labor troubles, builders' strikes, increased price of materials, and the generally unsettled condition of the trade in 1903 had their effect upon the quarry industry. Vermont and Connecticut, however, showed a decided increase in value of production.

Massachusetts still holds first place in value of production, being closely followed by Maine, then by Vermont, California, Connecticut, and New Hampshire.

The decrease in value of the stone used for building purposes was from $7,034,832 in 1902 to $6,192,145 in 1903, or $842,687. In 1902 the increase over 1901 was $1,374,703. Rough building stone decreased in value from $2,175,082 in 1902 to $1,671,929 in 1903, a loss of $503,153. The stone quarried and dressed by the producer for building purposes decreased from $4,859,750 in 1902 to $4,520,216 in 1903, a loss of $339,534.

The stone sold for monumental work in 1903, including the rough stock sold by the quarrymen for this purpose, and the stone quarried and dressed for this purpose by the quarrymen, was worth $3,808,417; in 1902 this value was $3,998,911, a loss of $190,494 in 1903. The rough monumental stock was valued at $1,692,880 in 1903, and at $1,714,156 in 1902, a loss for 1903 of $21,276. The dressed stone was valued at $2,115,537 in 1903, and at $2,284,755 in 1902, a decrease for 1903 of $169,218.

The value of the paving blocks increased from $1,523,776 in 1902 to $1,954,266 in 1903, an increase of $430,490.

The crushed stone increased in value from $3,211,780 in 1902 to $3,780,487 in 1903, an increase of $568,707.

The following table shows the production of granite in the United States in 1902 and 1903, by States and uses:

Value of granite produced in the United States in 1902 and 1903, by States and uses.

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	230,968	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	12,583
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	323,289	17,500	30,521	35,955	7,301
Massachusetts	400,842	412,172	123,399	965,342	881,872	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	27,061	....	29,283	2,185	42,359	6,900	....
Montana	16,600	100	....	16,000	250	....	900	....
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	....	....
Total	2,175,082	1,714,156	543,914	4,859,750	2,284,755	1,523,776	823,846	52,880

Value of granite produced in the United States in 1902 and 1903, by States and uses—Continued.

1902.

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	18,808		19,241		3,451	5,435	157,708
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	115,085	700	4,330		948,474
New York	193,485	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	25,564	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
Total	1,902,439	574,780	734,561	500,176	319,158	248,671	18,257,944

Value of granite produced in the United States in 1902 and 1903, by States and uses—Continued.

1903.

State.	Sold in the rough.			Dressed for building.	Dressed for monumental work.	Made into paving blocks.	Curbing.	Flagging.
	Building.	Monumental.	Other.					
Arizona					$3,000			
California	$34,064	$48,351	$284,509	$479,979	81,869	$92,082	$46,290	$470
Colorado	12,855	8,122		77,188	526		1,500	
Connecticut	71,041	26,164	93,699	408,875	58,811	85,686	24,398	805
Delaware	63,462		185,680	8,034	214	11,812	4,654	89
Georgia	39,585	34,374	1,000	29,421	18,345	189,571	249,948	7,585
Idaho	1,500						1,250	
Indian Territory	840	90		2,350	400			
Maine	267,778	43,961	10,016	1,300,608	159,478	639,607	96,367	12,475
Maryland	228,896	29,996	1,400	271,929	10,634	38,104	21,174	3,992
Massachusetts	324,683	374,544	44,875	648,471	211,175	349,066	65,148	18,049
Minnesota	21,992	14,161	682	53,474	172,927	73,950	34,351	2,678
Missouri	2,680	28,593	413	11,732	100	20,178	11,125	31,159
Montana	3,430	2,000		11,863	2,100		600	
Nevada	950	2,500					4,000	
New Hampshire	115,524	57,775	6,964	282,014	252,044	58,708	35,603	1,040
New Jersey	50,824	6,800	360	20,672	12	41,605		
New York	86,406		42	51,172	2,400	3,500	801	
North Carolina	8,259	510	3,888	44,628	6,760	7,215	36,915	1,375
Oklahoma		1,000			4,000			
Oregon	1,533	2,325	230	1,691	16,390	80	200	150
Pennsylvania	167,442		426	91,594	1,300	28,706	10,220	343
Rhode Island	9,890	111,458	2,040	149,114	360,043	37,984	11,570	705
South Carolina	13,300	29,000	192,500	157,100	1,900	5,600	4,150	196
Texas	3,839	19,475	22,611	2,600	5,675		1,275	
Utah	661	2,490	560					
Vermont	108,353	828,508	579	346,298	481,346	28,839	10,647	
Virginia	26,345	13,440		14,740	43,845	28,034	4,582	5,485
Washington	6,612	2,775		50,792	17,604	12,000	23,381	
Wisconsin	4,185	4,468	750	3,882	202,639	201,939	869	4,546
Total	1,671,929	1,692,880	858,224	4,520,216	2,115,537	1,954,266	701,018	91,142

Value of granite produced in the United States in 1902 and 1903, by States and uses—Continued.

1903.

State.	Crushed stone.			Rubble.	Riprap.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.				
Arizona							$3,000
Arkansas	$4,813	$23,500	$15,823	$3,000			47,136
California	112,298	74,039	200,891	162,089	$9,161	$1,500	1,627,592
Colorado	150		450				100,791
Connecticut	116,236	34,164	57,207	32,752	91,587		1,101,425
Delaware	14,245	47,976	21,000	6,000	6,000		369,166
Georgia	1,800	30,350	27,612	26,792	5,770	10,794	672,947
Idaho							2,750
Indian Territory				350			4,030
Maine	5,254	3,318	3,106	6,920	15,920	21,957	2,586,765
Maryland	60,664	37,771	122,120	8,278	1,029	1,800	837,787
Massachusetts	288,685	36,868	122,121	191,212	40,895	4,274	2,720,066
Minnesota	20,706	734	700	7,069	457	25	403,906
Missouri	38,384		4,443		1,252	350	150,409
Montana				5,000	1,000		25,993
Nevada							7,450
New Hampshire	7,850	2,470	6,087	9,275	18,684	475	854,513
New Jersey	575,338	86,109	150,224		5,733	3,390	943,171
New York	283,480	40,000	81,214				549,015
North Carolina	3,447	91,001	5,984	630	3,255	5,080	218,947
Oklahoma							5,000
Oregon	12,000	1,500	3,000	73,587	5,725		118,411
Pennsylvania	145,923	182,425	149,852	12,898	34,331	4,080	829,535
Rhode Island	18,031		2,597	3,650	619	2,590	710,291
South Carolina	13,000	36,797	7,780	15,450	90		476,863
Texas	25		64,725		58,100		173,325
Utah					92		3,803
Vermont	3,321	3,720	2,500		356	717	1,810,179
Virginia	31,785	17,400	60,820	28,449	22,410	2,000	299,335
Washington	3,608		9,631	9,048	73,644		209,095
Wisconsin	135,148		14,267	591		107	573,391
Total	1,896,191	750,142	1,134,154	605,139	391,110	59,139	18,436,087

The following table shows the value of the production of granite in the United States from 1899 to 1903, inclusive:

Value of granite produced in the United States, 1899–1903.

State.	1899.	1900.	1901.	1902.	1903.
Arizona	....	....	....	$3,000	$3,000
Arkansas	$39,470	$62,500	$23,554	12,115	47,136
California	471,665	788,993	1,134,675	1,187,679	1,627,592
Colorado	78,261	143,064	138,996	66,023	100,791
Connecticut	516,886	507,754	616,654	812,141	1,101,425
Delaware	1,039,349	608,028	671,204	276,758	369,166
Georgia	411,344	380,434	761,646	808,778	672,947
Idaho	....	2,450	5,100	12,910	2,750
Indian Territory	....	....	....	....	4,030
Kansas	....	30,000	48,530	....	....
Maine	1,321,082	1,568,578	2,703,116	2,659,450	2,586,765
Maryland	423,823	486,822	613,356	758,208	837,787
Massachusetts	1,798,294	1,698,605	2,216,258	3,451,397	2,720,066
Michigan	....	3,957	2,706	....	....
Minnesota	159,459	221,684	260,105	478,989	403,906
Missouri	151,688	139,103	95,806	157,708	150,409
Montana	....	....	....	77,050	25,983
Nevada	9,950	9,091	19,300	2,090	7,450
New Hampshire	802,636	870,646	935,494	1,147,097	864,513
New Jersey	779,822	1,170,555	894,167	948,474	943,171
New York	306,711	446,171	489,828	651,014	549,015
North Carolina	225,544	257,962	261,288	338,750	218,947
Oklahoma	....	....	....	....	5,000
Oregon	3,012	5,313	10,754	38,429	118,411
Pennsylvania	385,101	396,271	486,008	661,062	829,595
Rhode Island	400,128	444,816	501,698	734,623	710,291
South Carolina	361,034	500,802	996,084	598,848	476,863
South Dakota	91,049	114,115	99,941	(a)	(a)
Texas	84,945	76,069	27,005	60,008	173,325
Utah	4,735	2,170	5,588	1,479	3,808
Vermont	1,212,967	1,113,788	1,245,828	1,570,423	1,810,179
Virginia	223,380	211,080	275,701	282,046	299,335
Washington	42,766	48,900	43,808	147,273	209,096
Wisconsin	270,588	407,711	389,953	369,187	573,391
Wyoming	2,700	8,700	2,810	....	....
Total	11,618,339	12,675,617	15,976,961	18,257,944	18,436,067

a Value of quartzite included in sandstone.

The following tables show the value of the trap rock produced in the United States in 1902 and 1903, by States and uses:

Value of trap rock produced in the United States in 1902 and 1903, by States and uses.

1902.

State.	Building.	Paving.	Crushed stone.			Other.	Total.
			Road making.	Railroad 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	582,128	59,546	30,835	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

1903.

State.	Building.	Paving.	Road making.	Railroad ballast.	Concrete.	Other.	Total.
California	$152,383	$25,120	$71,538	$22,977	$193,731	$577	$466,326
Connecticut	11,620	22,426	114,986	34,164	46,288	....	229,484
Massachusetts	51,392	....	212,127	23,322	82,168	80	369,089
New Jersey	14,611	39,704	575,338	86,109	100,224	3,050	819,036
New York	....	....	283,480	40,000	65,945	....	389,425
Pennsylvania	9,336	5,476	129,824	180,225	129,991	4,632	458,984
Total	239,342	92,726	1,386,793	386,797	618,347	8,289	2,732,294

SANDSTONE.

The value of the sandstone, including the bluestone from New York and Pennsylvania, quarried in the United States in 1903, was $11,262,259. This is an increase of $661,088 over the value for 1902, which was $10,601,171. The increase in value in 1902 over 1901 was $2,462,491—from $8,138,680 in 1901 to $10,601,171 in 1902. The increase in the sandstone production, not including bluestone, was comparatively small, being $45,156—from $9,437,646 in 1902 to $9,482,802 in 1903. The bluestone output increased in value $615,932, from $1,163,525 in 1902 to $1,779,457 in 1903.

No sandstone used for the manufacture of grindstones, whetstones, etc., or for grinding into sand, is included in these figures.

Most of the States showed a decreased production. Alabama, Arizona, California, Colorado, Iowa, Minnesota, Nebraska, New York, Pennsylvania, South Dakota, Tennessee, Virginia, Washington, and Wyoming were the only States showing an increase, and of these Arizona, California, New York, and Pennsylvania were the only ones at all remarkable.

Pennsylvania, Ohio, and New York were the largest producers, and in 1903 their production was valued, respectively, at $3,255,073, $1,793,379, and $1,756,501. The next State approaching these States in production was California, with a value of $762,327. The production of the three principal States in 1902 was: Pennsylvania, $2,800,108; Ohio, $2,078,754; and New York, $1,408,699.

In 1901 the total value of the sandstone sold by the quarrymen for building purposes was $4,875,973; in 1902 it was $6,007,484, an increase of $1,131,511 over 1901; in 1903 it was $6,403,969, an increase of only $396,485 over 1902. The value of the crushed stone decreased from $1,116,449 in 1902 to $827,585 in 1903, or $288,864; ganister increased from $112,600 to $187,689, or $75,089; riprap decreased from $269,269 to $260,147, or $9,122; rubble increased from $645,619 to $656,933, or $11,314; paving increased from $527,617 to $696,053, or $168,436; flagstones increased from $1,142,699 to $1,164,156, or $21,457; and curbstones increased from $672,654 to $1,003,528, or $330,874.

From these figures it will be seen that the building stone output varied more than any other product, which is accounted for by the general depression in the building market due to labor troubles.

The following tables show the values of the sandstone production of the United States in 1902 and 1903, by States and uses:

Value of sandstone produced in the United States in 1902 and 1903, by States and uses.

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	98,116	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	70,985	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	21,858
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	85,358	83	680	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

Value of sandstone produced in the United States in 1902 and 1903, by States and uses—Continued.

1902.

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
Idaho	5,520					13,777
Illinois	2,925	2,400	160		405	32,200
Indiana	1,069	240	120	4,585		37,508
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	280,158	272,831	6,826	1,408,690
North Carolina	75					4,825
Ohio	44,471	750	664,659	43,077	14,135	2,078,754
Oklahoma, Oregon						25,309
Pennsylvania	202,295	26,985	104,521	174,184	40,461	2,800,106
South Dakota	24,447	39,260		500	600	110,785
Tennessee					120	7,670
Texas	7,000			22,850	757	165,565
Utah		35,000	2,200	4,010	7	106,011
Virginia						2,500
Washington	5,000					38,725
West Virginia	79,030		2,745	15,635		423,582
Wisconsin	29,760	160		112	12,575	207,086
Wyoming	10,096	5,000	600	50		90,601
Total	645,619	527,617	1,142,699	672,654	106,780	10,601,171

Value of sandstone produced in the United States in 1902 and 1903, by States and uses—Continued.

1903.

State.	Rough building.	Dressed building.	Crushed stone. Road-making.	Crushed stone. Railroad ballast.	Crushed stone. Concrete.	Ganister.	Riprap.
Alabama	$2,800	$6,000					$13,995
Arizona	7,000	425,000		$625	$12,500		50,000
Arkansas	4,415	3,555	$960	960	11,156		1,881
California	20,450	547,000	49,750	15,000	16,170		10,100
Colorado	56,192	13,075		30,000	7,635	$18,975	2,000
Connecticut	115,765	3,652					
Idaho	10,787	1,069					
Illinois	16,319	4,269				600	100
Indiana	19,062	4,910	5,000				1,280
Iowa	8,072	49	366	16			7,525
Kansas	15,431	7,650	600	31,250			500
Kentucky	51,997	23,200	1,100				1,085
Maryland	795		1,375				
Massachusetts	72,328	93,360	157,039	14,000	33,680		
Michigan	89,931	10,365	2,050		3,450		
Minnesota	41,359	39,424	4,500		16,221		7,508
Missouri	23,511	14,931	24				2,500
Montana	11,087	46,175			165		2,450
Nebraska	1,000		30				
Nevada	100	2,000					
New Jersey	270,253	91,721	1,750		200		
New Mexico	1,955	1,758			250		
New York	131,268	555,379	5,000	1,500	22,894		25,532
North Carolina	600						
Ohio	471,106	407,170	32,080	300	5,908	5,897	34,428
Oklahoma	2,900	3,000	600				
Oregon	1,654	793	97				300
Pennsylvania	550,991	1,602,152	12,919	185,452	26,442	143,639	46,797
South Dakota	50,868	40,895	500	500	5,000		7,119
Tennessee	600	19,536			93		
Texas	18,795	19,455	7,000		15,300		41,506
Utah	39,958	12,031					
Virginia	2,682	986			808		
Washington	1,100	32,450					
West Virginia	57,978	109,469	5,460	8,125	1,617		2,285
Wisconsin	56,699	18,870	1,125	260	165	18,578	1,256
Wyoming	11,240	3,572			70,623		
Total	2,239,048	4,164,921	289,325	287,988	250,272	187,689	260,147

Value of sandstone produced in the United States in 1902 and 1903, by States and uses—Continued.

1903.

State.	Rubble.	Paving.	Flagstone.	Curbstone.	Other.	Total.
Alabama	$15,021				$5,117	$42,933
Arizona	31,750					526,875
Arkansas	10,286	$3,993	$3,776	$19,684	506	61,172
California	98,852	375		1,100	3,530	762,327
Colorado	61,288	2,962	168,509	25,689	2,807	389,132
Connecticut						119,417
Idaho						11,866
Illinois	4,400		374	50	181	26,298
Indiana	2,010	93	78	168	50	32,651
Iowa	2,502	170	190	121		19,011
Kansas	4,754	5,100	21,141	15,502	200	102,128
Kentucky	10,000		5,560	800		93,742
Maryland						2,170
Massachusetts	2,071					372,478
Michigan	15,554					121,350
Minnesota	31,186	187,374	552	34,210	928	363,262
Missouri	5,060	15	1,482	1,639	240	49,402
Montana	1,759		1,260	4,140	1,000	68,086
Nebraska	10				27	1,067
Nevada	100	20		150		2,370
New Jersey			40	373		354,337
New Mexico	2,082		500	1,015		7,510
New York	4,237	356,788	231,366	412,922	9,615	1,756,501
North Carolina						600
Ohio	65,043		582,046	290,586	8,815	1,798,879
Oklahoma						6,500
Oregon	68					2,912
Pennsylvania	156,818	83,243	192,225	228,204	26,191	3,255,078
South Dakota	23,277	34,558		355		163,067
Tennessee	420					20,649
Texas	4,425		1,200	5,425	1,275	114,381
Utah	766	15,000	1,500	2,024		71,279
Virginia						4,471
Washington	11,000	1,800		1,080		47,490
West Virginia	43,541	4,567	709	17,671	782	252,204
Wisconsin	43,909		648		935	142,445
Wyoming	4,794		1,000	620		91,849
Total	656,983	696,053	1,164,156	1,008,528	62,199	11,262,259

The following table shows the value of the sandstone production in the United States from 1899 to 1903, inclusive, by States:

Value of sandstone production in the United States, 1899–1903, by States.

State.	1899.	1900.	1901.	1902.	1903.
Alabama	$71,675	$7,132	$8,680	$42,706	$42,933
Arizona	4,168	64,000	202,500	107,910	526,875
Arkansas	73,616	104,923	62,825	85,917	61,172
California	261,193	200,090	301,028	462,328	762,327
Colorado	129,815	119,658	237,331	366,161	389,132
Connecticut	271,623	192,593	146,814	128,579	119,417
Georgia	....	600	....	1,250	....
Hawaii	....	....	....	6,688	....
Idaho	....	438	20,843	13,777	11,856
Illinois	16,133	19,141	12,884	32,200	26,293
Indiana	35,636	45,063	28,334	37,593	32,651
Iowa	24,348	19,063	14,341	15,061	19,011
Kansas	49,629	55,173	49,901	105,509	102,128
Kentucky	119,982	56,178	108,259	128,470	98,742
Louisiana	a 226,503	b 118,192	....	....	....
Maryland	24,426	6,655	4,546	15,405	2,170
Massachusetts	131,877	153,427	247,310	487,366	372,478
Michigan	320,192	238,650	174,428	188,073	121,350
Minnesota	294,615	267,000	246,685	347,472	363,262
Missouri	57,662	53,401	42,170	56,990	49,402
Montana	26,160	59,630	58,439	85,152	68,036
Nebraska	....	....	515	168	1,067
Nevada	....	....	....	6,115	2,370
New Jersey	147,768	198,234	244,512	406,726	364,337
New Mexico	1,829	2,500	....	12,291	7,510
New York	c 1,218,053	c 1,467,496	c 1,331,327	c 1,408,699	c 1,756,501
North Carolina	10,300	27,210	11,682	4,825	600
Ohio	1,775,642	2,233,596	1,999,180	2,078,754	1,793,379
Oklahoma	....	....	....	25,309	6,500
Oregon	4,153	5,450	531		2,912
Pennsylvania	c 717,053	c 1,050,248	c 2,063,082	c 2,800,108	c 3,255,073
South Dakota	18,325	12,675	17,647	110,789	163,067
Tennessee	....	11,300	10,342	7,670	20,649
Texas	35,738	37,038	111,568	165,565	114,381
Utah	29,091	66,733	38,919	105,011	71,279
Virginia	8,000	6,000	5,303	2,500	4,471
Washington	58,395	68,133	89,174	30,725	47,430
West Virginia	33,860	72,438	103,010	423,532	252,204
Wisconsin	132,901	81,571	90,425	207,086	142,445
Wyoming	32,583	27,671	54,145	90,691	91,849
Total	6,362,944	7,149,300	8,138,680	10,601,171	11,262,259

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 1902 and 1903:

Value and uses of bluestone produced in New York and Pennsylvania in 1902 and 1903.

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

1903.

State.	Building purposes.	Flagging.	Curbing.	Crushed Stone.	Other purposes.	Total value.
New York	$588,015	$205,558	$230,345	....	$3,050	$1,026,968
Pennsylvania	323,763	173,701	126,593	$45,971	82,462	752,489
Total	911,777	379,259	356,938	45,971	86,512	1,779,457

From these tables it appears that the value of the bluestone output increased from $1,163,525 in 1902 to $1,779,457 in 1903, or $615,932. The production of both States increased in value, in New York, from $697,713 in 1902 to $1,026,968 in 1903, or $329,255, and Pennsylvania, from $465,812 in 1902 to $752,489 in 1903, or $286,677.

SLATE.

In 1903 the slate production of the United States increased in value $560,834, from a total of $5,696,051 in 1902 to $6,256,885 in 1903. In 1902 the increase was $908,526, from $4,787,525 in 1901 to $5,696,051 in 1902. In 1902 there were 1,435,168 squares of slate produced, valued at $4,950,428; in 1903 there were 1,378,194 squares of slate produced, valued at $5,400,078, a decrease of 56,974 squares and an increase of $449,650 in value, as compared with the output of 1902, which showed an increase over 1901 of 130,789 squares and of $836,018 in value. The milled slate increased in value from $745,623 in 1902 to $856,807, or $111,184

The slate trade in 1903 was reported in many cases as being very active during the first nine months of the year, but the remaining three months showed a much decreased demand. This was due to strikes in the building trade. Contractors did not give orders for slate which on account of stoppage of building work would be thrown on their hands for an indefinite period. This unsettled condition increased the price of slate and forced wages up. Pennsylvania and Vermont, the chief slate-producing States, showed a decrease in number of squares produced, with a considerable increase in the value. In the other larger States both the number of squares and the value increased. In all cases the milled slate increased, and a steady demand was reported for this slate all through the year.

The development of the Arkansas and West Virginia slate continued, and slate properties without commercial production were also worked in Colorado, Georgia, North Carolina, Tennessee, and Utah.

The average price per square increased from $3.45 in 1902 to $3.91 in 1903.

The decreased export trade, due in part to the practically settled strike in the Welsh quarries and in part to the increased price of American slates and to the consequent importation into Great Britain of cheaper slates, was one factor in the small increase of the entire production. The increased cost of production of American slates due to labor troubles also affected the export trade.

The following tables show the value of roofing and milled slate produced in the United States in 1902 and 1903, by States:

Value of roofing and mill slate produced in the United States in 1902 and 1903, by States.

1902.

State.	Roofing slate.		Value of milled stock.	Total value.
	Number of squares.	Value.		
Arkansas	500	$4,000		$4,000
California	4,500	31,500		31,500
Georgia	1,000	4,000		4,000
Maine	26,468	143,832	$62,726	206,558
Maryland	22,569	117,155	929	118,084
New Jersey	8,000	32,000		32,000
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
Total	1,435,168	4,950,428	745,623	5,696,051

1903.

State.	Number of squares.	Value.	Value of milled stock.	Total value.
Arkansas	118	$709	$4,000	$4,709
California	10,000	70,000		70,000
Maine	27,377	157,911	73,319	231,230
Maryland	24,475	135,424	2,207	137,631
New Jersey	(a)	(a)		(a)
New York b	23,337	122,951	22,450	145,401
Pennsylvania	871,875	3,378,804	581,102	3,959,906
Vermont	391,366	1,418,923	173,729	1,592,652
Virginia	29,646	115,356		115,356
Total	1,378,194	5,400,078	856,807	6,256,885

a Included with New York. b Includes 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	1903	3.91

The following table shows the total value of the slate production of the United States from 1899 to 1903, inclusive:

Value of slate produced in the United States, 1899–1903.

State.	1899.	1900.	1901.	1902.	1903.
Arkansas				$4,000	$4,709
California	$6,642	$26,500	$18,608	31,500	70,000
Georgia		9,375	3,000	4,000	
Maine	181,766	177,342	202,325	206,558	231,230
Maryland	93,595	128,673	105,798	118,084	137,631
Minnesota		700	1,400		
New Jersey	(a)	13,600	30,000	32,000	(a)
New York	76,675	62,755	100,960	126,718	145,401
Pennsylvania	2,537,022	2,713,598	2,984,264	3,547,322	3,959,906
Tennessee	(a)	250			
Utah	(a)				
Vermont	872,673	917,462	1,162,191	1,464,918	1,592,652
Virginia	183,110	190,211	178,979	160,951	115,356
Other States	11,250				
Total	3,962,733	4,240,466	4,787,525	5,696,051	6,256,885

a Included in Other States.

EXPORTS.

The exports of roofing slate decreased, according to the figures of the Bureau of Statistics, Department of Commerce and Labor, from $945,352 in the fiscal year ending June 30, 1902, to $628,612 in 1903. There was a large decrease in the slate exported to the United Kingdom, which was valued at $477,251 in 1903, as compared with $731,556 in 1902.

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, in the fiscal years 1895–1903.

Port and customs district.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Baltimore, Md	......	$9,860	$101,581	$170,916	$99,083	$110,049	$135,571	$240,734	$221,933
Bangor, Me	......	350	......	......	......	577	1,144	449	1,170
Belfast, Me	......	......	......	......	......	......	......	375	......
Boston and Charlestown, Mass	$443	609	1,020	385	40,622	65,531	93,972	48,299	30,273
Newport News, Va	......	......	18,170	65,290	42,220	19,950	12,910	6,650	350
New York, N. Y	31,092	242,559	557,099	986,638	968,395	592,288	388,590	374,264	207,250
Passamaquoddy, Me	192	......	120	......	......	......	......	164	......
Philadelphia, Pa	......	2,300	94,865	136,916	205,779	150,254	236,090	243,701	120,240
Portland and Falmouth, Me	......	......	270	......	......	......	......	......	......
Brazos de Santiago, Tex	......	......	......	......	14	......	......	......	......
Corpus Christi, Tex	106	174	......	1,761	......	......	......	44	......
New Orleans, La	......	......	......	......	......	......	......	......	......
Paso del Norte, Tex	......	......	......	......	......	......	......	20	......
Puget Sound, Wash	......	......	......	22	67	......	1,436	1,343	1,504
San Diego, Cal	......	......	......	......	7	......	......	......	......
San Francisco, Cal	......	......	......	......	......	......	......	......	1,222
Arizona	......	......	......	......	......	......	20	790	......
Buffalo Creek, N. Y	4,748	5,903	2,378	4,141	6,364	6,584	19,193	18,014	35,185
Champlain, N. Y	1,961	1,617	613	3,015	937	2,320	2,446	6,561	5,771
Detroit, Mich	65	2,874	2,427	854	129	1,441	380	......	......
Huron, Mich	......	......	......	......	......	424	......	......	......
Memphremagog, Vt	......	......	......	......	......	......	644	246	......
North and South Dakota	......	......	......	137	......	612	942	......	......
Oswegatchie, N. Y	......	......	......	......	......	487	4,915	3,702	3,714
Vermont	200	139	1,569	......	......	26	9	......	......
Total	38,806	266,385	780,112	1,370,075	1,363,617	950,543	898,262	945,352	628,612
Belgium	......	......	......	......	524	......	......	......	89
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	8,000	197,440	695,980	1,213,377	1,188,962	813,918	727,088	731,556	477,251
Denmark	......	......	......	8,150	25,823	25,437	43,344	47,957	17,376
Norway and Sweden	......	......	......	270	669	859	1,857	25	......
Bermuda	1,550	2,312	1,396	157	230	202	3,222	443	765
Dominion of Canada:									
Nova Scotia, New Brunswick, etc	406	1,278	730	......	288	798	1,269	532	1,183
Quebec, Ontario, etc	6,974	10,533	6,977	8,147	7,430	11,894	27,587	28,600	44,670
British Columbia	......	......	......	22	67	......	2,378	1,343	1,504
Newfoundland and Labrador	13	......	......	......	......	30	......	......	......
Central American States:									
Costa Rica	......	......	......	......	......	......	......	1,268	423
Guatemala	......	......	......	1,755	......	......	......	......	......
Honduras	......	......	......	......	......	......	......	......	......
Mexico	488	821	150	1,872	330	......	20	854	479
Miquelon, Langley, etc	......	......	......	35	......	......	60	......	......
West Indies:									
British	4,419	1,159	1,860	2,356	1,400	2,049	1,067	6,609	4,724
Haiti	......	......	......	26	......	332	......	......	52

Exports of slate from the United States, showing ports and customs districts from which and to which sent, in the fiscal years 1895-1903—Continued.

Port and customs district.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
West Indies—Continued.									
Santo Domingo	$10								
Cuba	3,258	$90		$673	$16				
Colombia		259	$100			$285			
Guianas:									
British	702	440	165	600					
Dutch	340		1,640	1,325	2,275	650		$365	$1,399
Peru						1,000			
Uruguay		417		807	760	829	$424	195	
China				110					
East Indies—British		1,628	810	550				50	
British Australasia	17,363	34,970	60,604	44,642	64,434	71,881	79,319	121,921	75,976
British Oceania									1,22
Hawaiian Islands		245	166		77				
British Africa, South	258	1,883	1,598	2,218	4,335	2,458	4,847	679	1,499
Portuguese Africa				42	3				
Total	38,806	266,385	780,112	1,370,075	1,363,617	950,543	898,262	945,352	628,612

MARBLE.

The marble production of 1903 was valued at $5,362,686, an increase of $318,504 over the value for 1902, which was $5,044,182. Arkansas and Montana had no output in 1903, but North Carolina was added to the list of producers. The increase was from the quarries in New York and Vermont; the production in the other States decreased somewhat.

Strikes in the building trade affected the marble industry as well as the other branches of the stone business.

The following table shows the value of the marble produced in the United States from 1899 to 1903, inclusive, by States:

Value of marble, by States, from 1899 to 1903, inclusive.

State.	1899.	1900.	1901.	1902.	1903.
Alabama		$500		(a)	(a)
Alaska			$4,500		
Arizona		5,000	300		(a)
Arkansas	$3,410		300	(a)	
California	6,500	17,500	6,642	$92,298	$78,329
Colorado	10,776				
Connecticut				(a)	(a)
Georgia	742,554	631,241	936,549	660,517	565,605
Idaho		1,250			
Maryland	77,000	70,000	68,100	(a)	83,672
Massachusetts	59,416	130,735	126,546	165,489	154,228
Missouri		900	2,100		(a)
Montana		1,200	1,500	(a)	
New Mexico		4,500	10,600	(a)	(a)
New York	338,816	332,518	379,159	577,298	748,160
North Carolina					4,365
Oregon			500		
Pennsylvania	139,506	151,167	157,547	160,423	93,200
Tennessee	b 384,705	424,054	494,637	518,256	485,905
Utah	2,355		320	(a)	3,200
Vermont	2,241,806	2,484,852	2,758,583	2,628,164	3,011,505
Washington	4,837	11,836	22,816	61,176	40,117
Wyoming					3,100
Other States				c 180,561	d 91,300
Total	4,011,681	4,267,253	4,965,699	5,044,182	5,362,686

a Included in Other States.
b Contains small amount from North Carolina.
c Includes Alabama, Arkansas, Connecticut, Maryland, Montana, New Mexico, and Utah.
d Includes Alabama, Arizona, Connecticut, Missouri, and New Mexico.

The following table shows the various uses to which the marble quarried in 1899, 1900, 1901, 1902, and 1903 was put:

Distribution and value of output of marble in 1899, 1900, 1901, 1902, and 1903 among various uses.

Use.	1899.	1900.	1901.	1902.	1903.
Sold by producers in rough state	$640,585	$491,813	$591,667	$2,276,629	$2,454,263
Dressed for building	1,176,208	1,080,969	1,236,023	1,038,102	1,111,072
Ornamental purposes	92,942	13,754	126,576	7,300	51,359
Dressed for monumental work	1,650,155	2,019,474	1,948,892	956,870	1,062,339
Interior decoration in buildings	389,040	555,092	1,008,482	679,913	663,553
Other uses	62,801	106,151	54,059	85,268	20,100
Total	4,011,681	4,267,253	4,965,699	5,044,182	5,362,686

The following table shows the value of the marble produced in the United States in 1902 and 1903, by States and uses:

Value of the marble product, by States and uses, 1902 and 1903.

1902.

State.	Rough.			Dressed.					Other purposes.	Total.
	Building.	Monumental.	Other.	Building.	Monumental.	Ornamental.	Interior decoration.	Other purposes.		
Alabama										(a)
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	15,244	5,044,182

1903.

State.	Rough.			Dressed.					Other purposes.	Total.
	Building.	Monumental.	Other.	Building.	Monumental.	Ornamental.	Interior decoration.	Other purposes.		
Alabama										(a)
Arizona										(a)
Arkansas										
California	$6,879			$20,000	$1,200		$48,000	$2,000	$250	$78,329
Connecticut										(a)
Georgia	271,432	$198,223	$50,000	25,000		$18,000	2,950			565,605
Maryland	28,180	25,065	30,427							83,672
Massachusetts	5,387		5,000	134,600		2,400	6,841			154,228
Missouri										(a)
Montana										
New Mexico										(a)
New York	195,506	64	7,595	356,561	179,434					748,160
North Carolina		4,365								4,365
Oregon d										
Pennsylvania	5,090	200	194	56,866	27,000				3,850	93,200
Tennessee	94,500	15,000	125,279	134,226	8,500		99,600	18,700	100	485,905
Utah	200	3,000								3,200
Vermont	485,990	649,887	227,400	280,058	847,258	18,850	502,062			3,011,505
Washington	7,500	800		14,761	3,847	12,009	1,000	200		40,117
Wyoming							8,100			8,100
Other States e	6,400		4,700	80,000	100	100				91,300
Total	1,107,064	896,604	450,595	1,111,072	1,062,339	51,359	663,553	15,900	4,200	5,352,686

a Included in Other States.
b Production of Missouri and Oregon included under report on limestone.
c Includes Alabama, Arkansas, Connecticut, Maryland, Montana, New Mexico, and Utah.
d Production of Oregon included under report on limestone.
e Includes Alabama, Arizona, Connecticut, Missouri, and New Mexico.

LIMESTONE.

The limestone production in the United States in 1903, including limestone for furnace flux, was valued at $32,066,283; in 1902 the value was $30,231,003, a gain in 1903 of $1,835,280. In 1902 the increase over the value for 1901, which was $26,406,897, was $3,824,106.

The chief increase was in the value of crushed stone, which was $8,580,866 in 1903 as compared with $7,152,730 in 1902, an increase of $1,428,136. The value of lime, furnace flux, flagstone, curbstone, paving stone, and riprap increased slightly, while building stone and rubble decreased in value. In many cases building stone and lime were affected by the labor troubles.

The most important States in value of production were Pennsylvania, Ohio, Illinois, Indiana, New York, Missouri, and Wisconsin, in the order named, ranking as in 1902, except that Illinois and Ohio changed places.

The value of the limestone quarried and used by Portland cement manufacturers is not included in the total. No regular attempt was made to collect the figures of this production, but its value amounted to over $500,000.

The following tables show the value of the production of limestone in the United States in 1902 and 1903, by States and uses:

Value of the production of limestone in the United States in 1902 and 1903, by States and uses.

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				208,899				
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	282,490
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	10,565
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				1,083
Michigan	58,707	200	489	208,232	98,000	56,261	40,810	49,490
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	43,581	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	180,380
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				9,000
Tennessee	57,399	180	3,257	285,615		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	5,563,034	241,688	331,968	9,335,618	237,393	2,890,985	2,661,061	1,600,664

Value of the production of limestone in the United States in 1902 and 1903, by States and uses—Continued.

1902.

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			156,484	1,350	208,700
Connecticut			1,472		205,371
Florida		3,600			63,571
Georgia			5,760		111,589
Idaho			2,025		15,074
Illinois	358,699	154,624	214,881	42,758	3,222,608
Indiana	87,916	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	670,586
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	82,246	68,164	621,380
Minnesota	106,693	33,447		1,150	830,857
Missouri	147,151	43,998	14,065	11,809	1,697,139
Montana	175		88,000		104,725
Nebraska	24,114	16,515	4,407		145,473
Nevada					2,800
New Jersey			58,142		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			82,840		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	492,884	30,231,003

Value of the production of limestone in the United States in 1902 and 1903, by States and uses—Continued.

1903.

State or Territory.	Building purposes.	Flagging.	Curbing.	Paving.	Lime made.	Stone sold to lime burners.
Alabama	$48,903			$2,680	$216,894	$432
Arizona					1,260	
Arkansas	74,102			22,000	89,337	
California	25,000		$140		381,750	15,000
Colorado					43,042	10,595
Connecticut					152,568	
Florida	10,000				44,137	
Georgia	2,850				62,902	
Idaho	752				18,200	
Illinois	359,856	$44,927	19,233	288,098	479,801	1,638
Indiana	1,880,561	31,184	126,684	1,942	314,206	
Indian Territory					800	
Iowa	196,843	2,408	3,506	12,469	98,525	105
Kansas	138,779	6,057	12,457	5,175	14,460	20
Kentucky	172,774	2,589	19,222	12,300	50,988	
Maine					791,690	
Maryland	8,361	340	5,129	1,479	320,494	1,219
Massachusetts	3,715	1,000			262,815	
Michigan	36,528	5,150	250	49,000	218,609	132,600
Minnesota	318,288	20,745	11,494	4,843	66,619	100
Missouri	447,884	11,628	23,791	11,734	641,948	4,100
Montana	2,200				21,100	
Nebraska	54,591	687	775	22		1,624
Nevada					2,400	
New Jersey	3,260				120,796	20
New Mexico					1,000	
New York	401,742	5,259	9,703	250	535,845	163,829
North Carolina					600	
Ohio	320,432	13,230	51,694	27,796	971,011	36,305
Oklahoma	10,696	5,256	580		4,000	
Oregon	700				13,684	
Pennsylvania	156,783	3,216	4,750	59,818	1,431,863	19,173
Rhode Island					38,432	
South Carolina					43,830	
South Dakota	375				13,061	
Tennessee	81,769	1,047	11,670	925	198,613	50
Texas	30,720	2,910	19,056	120	74,038	80
Utah	11,645				493,290	
Vermont	6,110				180,769	
Virginia	5,325				336,461	1,665
Washington	8,100				222,052	4,896
West Virginia	81				152,947	13,385
Wisconsin	161,366	9,328	35,083	15,109	565,314	4,180
Wyoming	150				12,083	
Total	4,981,241	166,961	355,167	515,760	9,694,174	411,016

Value of the production of limestone in the United States in 1902 and 1903, by States and uses—Continued.

1903.

State or Territory.	Crushed stone.			Rubble.	Riprap.	Flux.	Other purposes.	Total.
	Road making.	Railroad ballast.	Concrete.					
Alabama		$400	$60	$300	$5,000	$444,735		$719,404
Arizona								1,260
Arkansas	$5,800	13		5,000	46,376			242,628
California	75,475	825	15,945	1,200		5,705	$90,086	611,126
Colorado				30	4,213	160,240		218,120
Connecticut						1,968		154,536
Florida		3,256			7,500			64,893
Georgia		6,000	1,600					73,352
Idaho								18,952
Illinois	386,685	588,364	407,774	265,852	112,433	246,379	5,231	3,206,271
Indiana	236,467	42,427	53,750	49,364	15,756	155,209	27,724	2,935,274
Indian Territory	650							1,450
Iowa	95,306	13,479	68,699	99,478	42,715		1,898	635,431
Kansas	20,038	212,140	24,050	35,180	19,779		6,934	495,069
Kentucky	131,122	264,490	54,708	968	14,272	16,478	6,679	746,590
Maine							1,863	793,553
Maryland	18,102	15,356	15,006	80		200	460	386,226
Massachusetts	50					4,891		272,471
Michigan	61,342	35,340	48,504	710	800	15,502	4,747	609,082
Minnesota	30,210	11,800	67,030	110,270	24,994	250	9,447	676,090
Missouri	323,920	330,731	387,005	180,201	99,497	22,060	32,189	2,516,688
Montana					94	129,300		152,694
Nebraska	8,449	33,500	32,503	19,849	27,538	8,080	100	187,718
Nevada								2,400
New Jersey	1,271		1,137	1,050		60,084	93	187,711
New Mexico								1,000
New York	559,744	203,820	470,650	68,546	16,625	72,113	35,630	2,543,756
North Carolina								600
Ohio	548,073	391,998	135,795	49,064	25,982	668,778	80,514	3,320,672
Oklahoma		30,000		2,583			1,625	54,690
Oregon				1,500	800			16,684
Pennsylvania	211,151	656,317	546,302	4,758	38,960	2,553,711	88,704	5,775,506
Rhode Island	300					583		39,315
South Carolina	850					100		44,780
South Dakota			19,026	510		6,304		39,266
Tennessee	13,117	53,221	42,430	12,172	2,828	186,903	829	555,574
Texas	23,898	27,765	6,968	13,161	1,971	55,551	5,815	262,053
Utah						103,465	10,500	618,900
Vermont	845		2,500		100	200	200	190,724
Virginia	300	16,205	9,238		22	199,989		569,205
Washington	250	1,700				60,703		297,701
West Virginia		148,446				243,135	30	558,024
Wisconsin	244,132	18,009	67,037	37,349	47,110	51,116	11,528	1,256,661
Wyoming								12,188
Total	2,997,547	3,105,602	2,477,717	959,175	555,365	5,423,732	422,826	32,066,283

The following table shows the production of limestone in the United States from 1899 to 1903, by States:

Value of limestone, 1899–1903, by States.

State.	1899.	1900.	1901.	1902.	1903.
Alabama	$364,636	$533,608	$619,423	$759,617	$719,404
Arizona	960	165	300	....	1,260
Arkansas	71,965	71,407	68,319	113,163	242,628
California	287,295	407,489	645,455	496,843	611,126
Colorado	96,456	160,587	245,790	203,700	218,120
Connecticut	162,388	148,060	140,424	205,371	154,586
Florida	44,002	128,881	51,870	63,571	64,883
Georgia	29,786	54,451	85,629	111,589	73,362
Idaho	3,325	34,587	21,251	15,074	18,942
Illinois	2,065,483	1,881,151	2,793,837	3,222,608	3,206,271
Indiana	2,173,833	2,344,818	2,993,186	2,865,691	2,985,274
Indian Territory	....	....	....	....	1,450
Iowa	785,576	586,410	777,484	649,984	685,431
Kansas	379,001	339,466	478,986	670,536	496,069
Kentucky	178,861	178,252	199,567	593,747	746,590
Maine	1,028,375	691,312	715,272	745,132	798,558
Maryland	235,225	317,207	882,381	453,030	386,226
Massachusetts	168,147	209,359	244,089	339,349	272,471
Michigan	371,210	425,636	565,931	621,380	609,082
Minnesota	496,462	441,554	522,778	830,857	676,090
Missouri	977,399	1,079,843	1,362,272	1,697,189	2,516,688
Montana	113,718	141,093	143,866	104,725	152,694
Nebraska	125,017	107,305	154,717	145,473	187,716
Nevada	....	....	....	2,800	2,400
New Jersey	153,025	170,006	309,738	181,650	187,711
New Mexico	....	....	....	....	1,000
New York	1,545,699	1,730,162	1,738,716	2,419,121	2,543,756
North Carolina	....	....	8,266	23,158	600
Ohio	1,798,604	1,969,387	2,606,502	3,201,718	3,320,672
Oklahoma	50,550	25,586	32,497	50,541	64,690
Oregon	8,000	10,900	24,520	20,133	16,664
Pennsylvania	3,088,583	3,800,818	5,081,387	5,420,287	5,775,506
Rhode Island	18,239	16,828	38,030	71,664	39,315
South Carolina	17,650	38,415	28,500		44,780
South Dakota	45,808	47,762	53,780	86,606	39,266
Tennessee	208,097	238,505	330,927	482,083	555,574
Texas	100,025	124,728	209,658	228,662	262,063
Utah	6,381	12,749	78,900	186,663	618,900
Vermont	282,173	188,100	205,138	225,703	190,724
Virginia	255,640	403,318	539,128	534,113	569,206
Washington	139,339	249,163	234,587	213,814	297,701
West Virginia	58,802	53,701	447,049	616,366	558,024
Wisconsin	826,486	969,685	1,225,448	1,351,058	1,256,661
Wyoming	742	3,065	1,340	6,340	12,183
Total	18,757,963	20,354,019	26,406,897	30,231,008	32,066,283

The following table shows the quantity and value of the blast-furnace flux produced in 1902 and 1903, by States:

Production of blast-furnace flux in 1902 and 1903, by States.

State.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Alabama	1,001,884	$465,065	1,006,814	$444,785
California	3,500	5,250	8,410	5,705
Colorado	402,735	155,484	353,849	160,240
Connecticut	2,942	1,472	3,698	1,968
Georgia	14,400	5,760	....	....
Idaho	2,025	2,025	....	....
Illinois	483,348	214,881	491,542	246,379
Indiana	438,717	187,265	400,268	155,209
Kentucky	36,354	15,487	33,836	16,478
Maine	2,000	1,000	....	....
Maryland	3,654	3,263	490	200
Massachusetts	2,732	1,398	6,792	4,891
Michigan	58,567	32,246	23,518	15,502
Minnesota	....	....	500	250
Missouri	25,115	14,065	25,953	22,060
Montana	198,000	88,000	229,000	129,300
Nebraska	8,814	4,407	10,150	8,080
New Jersey	110,371	53,142	119,294	60,084
New York	178,019	92,849	121,170	72,113
Ohio	1,559,933	630,325	1,632,367	668,778
Pennsylvania	5,645,857	2,461,426	5,558,051	2,553,711
Rhode Island	950	1,190	433	583
South Carolina	....	....	100	100
South Dakota	97,768	54,750	14,510	6,804
Tennessee	284,895	108,860	313,721	136,903
Texas	33,393	23,432	96,884	55,551
Utah	113,194	82,840	160,432	103,465
Vermont	250	125	400	200
Virginia	565,704	220,001	499,108	199,989
Washington	23,917	22,239	101,161	60,703
West Virginia	740,901	268,059	708,572	243,135
Wisconsin	89,309	50,946	108,696	51,116
Wyoming	10,000	4,000	....	....
Total	12,139,248	5,271,252	12,029,719	5,423,732

As will be seen from this table the production of limestone quarried for blast-furnace flux decreased from 12,139,248 long tons in 1902 to 12,029,719 long tons in 1903, a loss of 109,529 tons in quantity, while the value increased from $5,271,252 in 1902 to $5,423,732 in 1903, or $152,480.

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 1903 the great prosperity of the clay-working industries of recent years, as recorded in the reports of this office, was continued, though the gain in neither branch of the industry was so large as in 1902. At the beginning of the year, in view of the then unusually prosperous condition of the industry, the feeling among the operators appeared to be that the prosperity would be continued throughout 1903. That this feeling had a good foundation in fact is shown by the figures herein presented. These figures show that the value of the clay products marketed was the largest ever recorded in this country, and, perhaps, in any other, and that the product would have undoubtedly been much greater had not the element of labor disturbance been so much in evidence. The labor troubles were not within the clay-working industries, however, as no strikes—certainly none of importance—were recorded during the year. But the strikes in the building trades, especially in the large building centers, such as New York, Pittsburg, and Chicago, could not but have their effect on the consumption of building material, and though the higher prices realized for clay products upon the resumption of building may have offset, to a small extent, the lack of sales during the strikes, the fact remains, notwithstanding the increased value of the buildings erected in the large cities, that the consumption of clay products would have been greater had building operations in these centers been uninterrupted by strikes.

In spite of the increased cost of manufacture, the average price per thousand of brick, the only product for which quantities can be given, has increased but little—20 cents per thousand for common brick, 85 cents for front brick, and 55 cents for vitrified brick. This is an increase of but 3 per cent in case of common brick, 7 per cent for front brick, and 6 per cent for vitrified paving brick. Surely this is a most creditable showing for the clay manufacturers of the United States, as the increase in cost to the consumer in most other products has been much greater than in the case of clay products.

While the number of operating firms reporting is practically the same—6,033 in 1903 as compared with 6,046 in 1902—the average value of the output per plant increased from $20,207 in 1902 to $21,708 in 1903, showing that the plants are becoming larger rather than more numerous, which conforms to the tendency of the times. The average value of the output per plant in 1901 was $17,164; in 1900, $14,859. This is an increase in the average value of output per plant of $6,849, or over 46 per cent in three years. This does not mean that the plants have necessarily increased their capacity to that extent, but rather that the smaller plants have either gone out of existence or have been combined with or taken over by some plant already in existence. For the same reason the number of firms reporting does not by any means represent the number of plants in operation, as all of the plants in one State belonging to one firm or individual are counted as one plant. Thus, there are 144 firms reporting 518 plants, which, taken separately, would add 374 to the number of plants reported.

In the pottery industry there seemed to prevail, especially in the western district, the impression, perhaps well founded in some places, that the year's business was not so good as that of the previous year. However, from the returns furnished this office by the potters themselves, as shown in this report, it appears that on the whole the industry was prosperous, the product reported being even greater than that of 1902, but the proportional gain over 1902 was not so great as the gain of 1902 over 1901.

There are many small plants which make no report to this office, but the figures here presented are practically a census; for, it is believed, all the plants not included in these figures would represent considerably less than 1 per cent of the total, every plant whose product was valued at $10,000 or more being included.

The value of the clay products as shown in the appended tables increased from $122,169,531 in 1902 to $130,962,648, a gain of $8,793,117, or 7.20 per cent. The increase in 1902 over 1901 was $11,957,944, or 10.85 per cent. The gain in 1903 was, as is shown in one of the tables, participated in by both the brick and tile and the pottery branches of the industry.

The sand-lime brick industry, mentioned in the last report, made considerable progress during 1903. Several plants had their product on the market, and quite a number of new plants were built during the year, but the large majority were engaged in preliminary work and put no product on the market, though they will undoubtedly be factors in the production of 1904. Returns covering 16 operating plants show a marketed product of 20,860,000 brick, valued at $155,400, an average of $7.45 per thousand. These brick are not included in the tables in this report. Of these 16 operating plants three were located in Michigan, two each in California, New York, South Dakota, and Texas, and one each in Arizona, Maryland, New Jersey, North Carolina, and Pennsylvania.

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 being due to the efforts of the officers of the respective State geological surveys. The New York State Museum, Albany, N. Y., also cooperated in the collection of the statistics of the clay-working industries in that State for 1903.

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 1902 and 1903. These figures are from official sources, having been furnished in every case by the city officers in charge of the building departments. An effort was made in previous years 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 the figures here given 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 1902 and 1903.

City.	1902.		1903.	
	Number of permits.	Cost of buildings.	Number of permits.	Cost of buildings.
Allegheny, Pa	642	$2,206,150	734	$2,127,350
Atlanta, Ga	2,818	1,868,593	3,441	3,161,445
Boston, Mass	1,073	10,147,055	2,841	15,264,940
Brooklyn, N.Y. [a]	2,009	18,548,062	4,707	26,628,220
Buffalo, N.Y	2,109	5,433,078	2,011	6,263,402
Cambridge, Mass	607	2,232,365	519	1,290,694
Chicago, Ill	6,099	48,242,990	13,241	47,295,680
Cincinnati, Ohio	2,571	4,669,585	3,949	4,502,255
Cleveland, Ohio	3,172	6,559,545	3,226	6,250,931
Columbus, Ohio	1,389	2,706,815	1,529	3,909,189
Dayton, Ohio	1,200	1,364,610	1,200	1,000,000
Denver, Colo	1,667	4,551,151	1,946	4,725,491
Detroit, Mich	2,576	5,496,500	3,383	6,912,600
Fall River, Mass	342	1,481,350	386	1,023,900
Grand Rapids, Mich	1,045	1,332,095	1,114	1,178,561
Hartford, Conn	621	1,105,000	518	1,694,605
Indianapolis, Ind	2,764	2,989,758	2,532	3,026,292
Jersey City, N.J	948	2,491,817	1,103	3,011,951
Kansas City, Mo	3,979	8,054,248	3,644	7,705,375
Los Angeles, Cal	4,863	9,603,132	6,395	13,041,838
Louisville, Ky	1,835	2,828,457	1,749	2,428,332
Memphis, Tenn	2,480	2,119,824	2,342	2,383,764
Milwaukee, Wis	2,141	5,655,423	2,774	7,024,607
Minneapolis, Minn	7,183	7,056,017	7,882	7,720,804
Nashville, Tenn	5,723	1,160,199	6,049	1,420,912
Newark, N.J	1,301	9,044,162	1,695	5,473,779
New Haven, Conn	276	847,680	307	1,624,601
New Orleans, La	1,707	2,916,262	1,798	2,964,154
New York, N.Y. [b]	2,877	89,882,778	3,306	86,502,231
Omaha, Nebr	564	1,626,045	528	1,338,820
Philadelphia, Pa	8,954	29,992,260	9,257	33,487,211
Pittsburg, Pa	2,405	15,811,728	3,283	15,901,836
Providence, R.I	671	2,554,050	1,107	3,796,500
Reading, Pa	583	1,072,600	458	1,087,300
Richmond, Va	660	2,386,000	697	2,106,410
Rochester, N.Y	812	2,913,142	794	1,858,571
St. Joseph, Mo	785	1,039,664	758	953,045
St. Louis, Mo	4,502	12,854,036	4,802	14,544,490
St. Paul, Minn	1,289	5,151,480	1,470	3,645,775
San Francisco, Cal	1,670	14,001,472	2,136	17,264,245
Scranton, Pa	820	1,534,342	889	1,528,877
Seattle, Wash	2,980	5,471,620	6,914	6,495,751
Syracuse, N.Y	284	1,075,900	609	1,755,508
Washington, D.C	1,111	6,736,607	6,841	11,584,608
Worcester, Mass	366	1,654,395	697	2,335,961
Total	96,428	368,469,037	127,555	397,226,681

[a] The figures for Brooklyn cover the Borough of Brooklyn only.
[b] The figures for New York cover the Boroughs of Manhattan and the Bronx.

From this table it will seen that the 45 cities reporting show that the number of permits issued in 1903 was 127,555, compared with

96,423 in 1902, a gain of 31,132 in the number of permits, or 32.29 per cent, and that the value of the buildings erected under these permits increased from $368,469,037 in 1902 to $397,225,681, a gain of $28,756,644, or 7.80 per cent. The average value of the buildings, assuming that one permit was issued for each building, was $3,821 in 1902 and $3,114 in 1903. In Greater New York the number of permits issued increased from 4,886 in 1902 to 8,013 in 1903, while the value of the buildings erected thereunder increased from $108,430,840 in 1902 to $113,130,451 in 1903. This is an increase of 3,127, or 64 per cent, in the number of permits, but of only $4,699,611, or 4.33 per cent, in the value of the buildings to be erected under them. In New York City alone the permits increased from 2,877 in 1902 to 3,306 in 1903, a gain of 429, and the value of the buildings to be erected decreased from $89,882,778 to $86,502,231, a loss of $3,380,547. In Brooklyn the permits increased from 2,009 in 1902 to 4,707 in 1903, a gain of 2,698, and the value of the buildings increased from $18,548,062 in 1902 $26,628,220 in 1903, a gain of $8,080,158, or 43.56 per cent. Chicago, next to New York, shows the largest value in buildings erected; but in 1903, as in New York, while the number of permits increased the value of the buildings decreased. The table shows that the permits issued in 1902 were 6,099, in 1903, 13,241, an increase of 7,142, or more than 117 per cent, but that the value of the buildings decreased from $48,242,990 in 1902 to $47,295,660 in 1903, a loss of $947,330, or 1.96 per cent. Philadelphia, the next most important city in building operations, showed an increase in both the number of permits issued and in the value of the buildings erected. The number of permits issued increased from 8,954 in 1902 to 9,257 in 1903, an increase of 303, or 3.38 per cent, and the value of the buildings increased from $29,992,260 in 1902 to $33,487,211 in 1903, a gain of $3,494,951, or 11.65 per cent. San Francisco was the next city in value of buildings, those for which permits were taken out in 1903 being valued at $17,264,245, as compared with $14,001,472 in 1902, a gain of $3,262,773, or 23.30 per cent. Pittsburg and Boston are next in order with a gain of $90,108 and $5,117,885, respectively, the values of buildings erected being $15,901,836 and $15,264,940. St. Louis is the city of next importance, with building permits authorizing the erection of edifices valued at $14,544,430 in 1903, compared with $12,854,036 in 1902, a gain of $1,690,394, or 13.15 per cent. The largest relative gain was at New Haven, where the buildings rose in value from $847,680 in 1902 to $1,624,601 in 1903, a gain of $776,921, or 91.65 per cent. Washington, D. C., comes next, with a relative gain of nearly 72 per cent, and Atlanta, with a gain of 69.19 per cent. The cities to show losses in 1903 besides those mentioned, were Allegheny, Cambridge, Cincinnati, Cleveland, Dayton, Fall River, Grand Rapids, Kansas City, Louisville, Newark, Omaha, Richmond, Rochester, St.

Joseph, St. Paul, and Scranton. In the majority of these cities, however, the decreases were small. The average value per building in Boston in 1903 was $5,373 and $9,457 in 1902; in Brooklyn $5,657 in 1903 and $9,232 in 1902; in Chicago, $3,572 in 1903 and $7,910 in 1902; New York, $26,165 in 1903 and $31,242 in 1902; Philadelphia $3,618 in 1903 and $3,350 in 1902. It will be noted that in all of these large cities, except Philadelphia, the average cost per building decreased.

PRODUCTION.

In the following tables will be found statements of the values of the clay products of the United States in 1902 and 1903:

Value of the products of clay in the United States in 1903, by States and Territories.

State.	Brick and tile.	Pottery.	Total.
Alabama	$1,304,607	$23,320	$1,327,927
Arizona	109,756	....	109,756
Arkansas	578,846	11,600	589,946
California	2,782,065	49,478	2,831,543
Colorado	2,011,441	56,869	2,068,310
Connecticut and Rhode Island	1,093,619	a 112,450	1,206,069
Delaware	203,908	....	203,908
District of Columbia	319,657	10,854	330,511
Florida	221,295	....	221,295
Georgia	1,708,880	22,142	1,731,022
Idaho	164,107	....	164,107
Illinois	10,291,064	899,733	11,190,797
Indiana	5,113,656	580,969	5,694,625
Indian Territory	166,022	....	166,022
Iowa	3,037,641	55,762	3,093,403
Kansas	1,463,475	23,529	1,487,004
Kentucky	2,051,132	139,827	2,190,959
Louisiana	813,387	(b)	813,387
Maine	677,182	(b)	677,182
Maryland	1,435,566	473,255	1,908,821
Massachusetts	1,807,849	300,836	2,108,685
Michigan	1,662,414	48,007	1,710,421
Minnesota	1,527,008	397,578	1,924,586
Mississippi	662,787	14,295	677,082
Missouri	5,610,206	51,401	5,661,607
Montana	329,317	(b)	329,317
Nebraska	768,255	....	768,255
Nevada	99,905	....	99,905
New Hampshire	568,621	(b)	568,621
New Jersey	7,101,713	6,315,226	13,416,939
New Mexico	142,039	....	142,039
New York	7,934,174	1,274,078	9,208,252
North Carolina	848,264	14,232	862,496
North Dakota	127,085	....	127,085
Ohio	14,120,041	11,088,087	25,208,128
Oklahoma	368,955	....	368,955
Oregon	425,544	(b)	425,544
Pennsylvania	16,973,772	1,873,552	18,847,324
South Carolina	647,368	9,827	657,195
South Dakota	68,825	....	68,825
Tennessee	1,072,342	114,174	1,186,516
Texas	1,374,914	97,666	1,472,580
Utah	435,084	5,300	440,384
Vermont	114,001	(b)	114,001
Virginia	1,650,660	22,686	1,673,346
Washington	912,165	16,100	928,265
West Virginia	1,310,060	1,248,500	2,558,560
Wisconsin	1,293,810	13,586	1,307,396
Wyoming	22,663	....	22,663
Other States	....	c 71,133	c 71,133
Total	106,526,596	25,436,052	130,962,648
Per cent of total	80.58	19.42	100.00

a Produced by Connecticut alone.
b Included in Other States.
c Includes pottery products which could not be separately classified without disclosing the operations of individual establishments.

Value of the products of clay in the United States in 1902, by States and Territories.

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	1,531,006	370,725	1,901,731
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	123,214		123,214
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.

These tables show that the value of the clay products increased from $122,169,531 in 1902 to $130,962,648 in 1903, a gain of $8,793,117, or 7.20 per cent. The gain in 1902 over 1901 was $11,957,944, or 10.85 per cent. Had the labor troubles in the building trades been less pronounced the output of building brick in 1902 would have probably been reached, and, with the added value, the increase of 1903 over 1902 would have been as great as that of 1902 over 1901. Nevertheless, the increase is an indication of the healthy growth of the industry, which, unless unforeseen conditions arise, is bound to become one of the great industries of the country, owing to our magnificent supplies of clays in almost every State of the Union.

Of the total value mentioned above, the materials which enter into structural and engineering arts, the brick and tile of this classification, composed $105,526,596, or 80.58 per cent, and the finer products, pottery, composed 19.42 per cent. In 1902 these percentages were 80.25 and 19.75, respectively. These two classes of products have maintained about these proportions for several years.

The following table shows the value of the clay products of the United States from 1898 to 1903:

Value of the products of clay in the United States, 1898–1903, by States and Territories. (a)

State or Territory.	1898.	1899.	1900.	1901.	1902.	1903.
Alabama	$456,597	$897,810	$712,727	$946,791	$1,016,364	$1,327,927
Arizona	81,509	101,954	112,737	92,986	114,608	109,755
Arkansas	245,766	339,142	381,012	407,263	520,178	589,946
California	1,263,734	1,587,518	1,375,998	1,769,155	2,258,096	2,831,543
Colorado	766,767	1,071,388	1,200,519	1,594,867	2,200,983	2,068,310
Connecticut and Rhode Island	952,180	1,074,202	1,099,972	1,130,909	1,217,678	1,206,069
Delaware	160,555	168,485	156,274	131,164	144,934	203,908
District of Columbia	320,320	481,145	288,983	324,008	267,627	330,511
Florida	130,987	138,808	140,604	190,674	175,442	221,295
Georgia	857,258	1,263,995	1,193,218	1,545,083	1,508,669	1,731,022
Idaho	27,365	47,624	49,382	68,328	93,048	164,107
Illinois	6,866,715	7,259,825	7,708,859	9,642,490	9,881,840	11,190,797
Indiana	3,331,997	4,235,854	3,858,350	4,466,454	5,283,733	5,694,625
Indian Territory	35,633	35,075	30,238	117,224	167,674	166,022
Iowa	2,183,022	2,238,808	2,291,251	2,737,825	2,843,336	3,093,403
Kansas	444,975	839,767	1,016,750	981,020	1,221,588	1,487,004
Kentucky	1,000,940	1,358,428	1,481,824	1,514,543	1,878,043	2,190,959
Louisiana	517,059	554,729	507,694	615,703	642,424	813,387
Maine	600,029	662,685	724,934	734,678	656,648	677,182
Maryland	1,542,853	1,679,641	1,711,856	1,605,655	1,905,362	1,908,821
Massachusetts	1,809,070	2,181,710	1,833,101	1,870,837	2,375,667	2,108,685
Michigan	1,043,362	1,283,997	1,181,696	1,542,034	1,744,040	1,710,421
Minnesota	1,132,584	1,218,697	1,396,697	1,548,647	1,901,731	1,924,586
Mississippi	321,783	546,741	573,368	456,473	516,209	677,032
Missouri	3,112,716	3,666,616	3,736,567	4,474,553	5,166,414	5,661,607
Montana	275,026	314,340	350,489	539,221	278,727	329,317
Nebraska	518,565	848,315	683,958	806,473	757,668	768,255
Nevada	....	17,850	9,580	17,625	45,600	99,905
New Hampshire	439,189	570,287	485,018	765,964	887,124	568,621
New Jersey	8,706,357	10,787,273	10,928,423	11,681,878	12,613,263	13,416,939
New Mexico	41,940	108,090	41,898	81,345	68,879	142,039
New York	6,717,333	8,076,412	7,660,606	8,291,718	8,414,113	9,208,252
North Carolina	429,782	774,202	815,975	771,338	795,521	862,496
North Dakota	72,900	168,124	92,399	76,708	128,214	127,085
Ohio	13,167,627	16,500,625	18,804,628	21,574,985	24,249,748	25,208,128
Oklahoma	78,258	150,552	164,457	205,060	235,975	368,955
Oregon	181,864	827,374	281,385	[b] 263,891	[b] 318,604	425,544
Pennsylvania	9,714,683	14,108,245	13,391,748	15,321,742	17,833,425	18,847,324
South Carolina	259,282	605,329	711,336	575,218	613,511	657,195
South Dakota	30,770	46,500	43,440	59,365	63,425	68,825
Tennessee	520,038	948,853	915,578	898,967	913,125	1,186,516
Texas	817,797	1,221,119	1,171,017	1,723,375	1,693,814	1,472,580
Utah	180,992	216,449	234,221	291,189	359,005	440,384
Vermont	59,474	131,525	121,041	77,554	78,886	114,001
Virginia	894,883	1,093,784	1,305,195	1,439,347	1,577,833	1,673,346
Washington	250,988	591,277	625,459	944,798	905,231	928,265
West Virginia	1,098,575	1,451,539	2,016,765	1,946,480	2,518,544	2,558,560
Wisconsin	877,806	1,811,712	1,072,179	1,247,544	1,026,658	1,307,396
Wyoming	3,825	8,450	21,500	28,950	22,150	22,663
Other States	....	....	....	[c] 76,488	[d] 83,152	[e] 71,133
Total	74,487,680	95,797,870	96,212,345	110,211,587	122,169,531	130,962,648
Operating firms reporting	5,971	6,962	6,475	6,421	6,046	6,033

[a] In 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.

[e] Includes pottery products which could not be separately classified 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 and the number of firms reporting, and is a condensed statement of the industry for the period covered.

Notwithstanding the general prosperity, as shown by this table, eight States showed a decline in the value of their products as compared with 1902. Some of these decreases were, however, small, and as only one of these States, Texas, showed a decrease in 1902 it is only fair to assume that it was due most probably to local conditions that the clay-working industries in these States showed a slight falling off. The States showing the decreases are: Arizona, $4,853, or 4.23 per cent; Colorado, $132,673, or 6.03 per cent; Connecticut and Rhode Island, $11,609, or 0.95 per cent; Indian Territory, $1,652, or 0.99 per cent; Massachusetts, $266,982, or 11.24 per cent; Michigan, $33,619, or 1.93 per cent; New Hampshire, $318,503, or 35.9 per cent, and Texas, $221,234, or 13.06 per cent. The location of these States should be observed, four being in the West and Southwest, three in New England, and one in the Central West.

The States showing the largest increases were: Illinois, $1,308,957, or 13.25 per cent; Pennsylvania, $1,013,899, or 5.69 per cent; Ohio, $958,380, or 3.95 per cent; New Jersey, $803,676, or 6.37 per cent; New York, $794,139, or 9.44 per cent, and California, $578,447, or 25.67 per cent.

In the following table will be found a comparison of the several varieties of clay products made in 1902 and 1903, 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 1902 and 1903, with increase or decrease.

Product.	1902.	1903.	Increase in 1903.	Percentage of increase in 1903.
Common brick	$48,885,869	$50,532,075	$1,646,206	3.37
Front brick	5,318,008	5,308,908	a 9,100	a 1.76
Vitrified paving brick	5,744,530	6,453,849	709,319	12.35
Fancy or ornamental brick	335,290	322,567	a 12,723	a 3.79
Enameled brick	471,163	569,689	98,526	20.91
Fire brick and stove lining	12,601,435	14,062,369	1,460,984	11.59
Drain tile	3,506,787	4,639,214	1,132,427	32.29
Sewer pipe	7,174,892	8,525,369	1,350,477	18.82
Ornamental terra cotta	3,526,906	4,672,028	1,145,122	32.47
Fireproofing, hollow building tile or blocks, and terra-cotta lumber	3,175,593	3,861,343	685,750	21.59
Tile (not drain)	3,622,863	3,505,329	a 117,534	a 3.24
Miscellaneous	3,678,742	3,073,856	a 604,886	a 16.44
Total brick and tile	98,042,078	105,526,596	7,484,518	7.63
Total pottery	24,127,453	25,436,052	1,308,599	5.42
Grand total	122,169,531	130,962,648	8,793,117	7.20

a Decrease.

This table shows in a striking manner the results of the canvass of this Office and the lines along which there is most activity. It will be observed that four varieties of product showed a decrease—front brick, fancy ornamental "shape" brick, tile (not drain), and the miscellaneous products. The loss in the last is, however, of little importance, since it may mean merely that the products embraced in this column have been better classified and reported under some other classification. The other decreases are so small that they are hardly worth considering, so that the entire industry may be considered as having been in a highly prosperous condition in 1903.

As mentioned elsewhere, the disturbances in the labor world undoubtedly reduced the demand and consequently the consumption of building material, especially in the eastern centers, yet the value of the building brick increased from $55,010,330 in 1902 to $56,733,239 in 1903, a gain of $1,722,909, or 3.13 per cent. As compared with 1901, when the building brick were valued at $51,048,653, this is a gain of $5,684,586, or 11.14 per cent, which indicates a substantial growth in this branch of the industry.

The common-brick product increased in value from $48,885,869 in 1902 to $50,532,075 in 1903, an increase of $1,646,206, or 3.37 per cent. In 1902 this product showed a gain over 1901 of $3,382,793, or 7.43 per cent.

The front-brick product showed a small decrease—from $5,318,008 in 1902 to $5,308,908 in 1903, a loss in value of $9,100, or 1.78 per cent.

That the vitrified paving-brick industry is in a flourishing condition is shown by the steady gain in value that this product has made for several years, the increase in 1903 over 1902 being one of the largest gains recorded since this Office began the collection of figures relating to clay products, namely, $709,319, or 12.35 per cent, as compared with a gain of $260,396, or 4.75 per cent, in 1902 over 1901. The total value of this product was $5,744,530 and $6,453,849 in 1902 and 1903, respectively. This product is fourth in point of value, being exceeded only by common brick, fire brick, and sewer pipe, respectively.

The value of fancy-shaped brick showed a slight decline in value as compared with that of 1902, the figures being $335,290 in 1902 and $322,567 in 1903, a loss of $12,723, or 3.79 per cent.

The enameled brick product showed a gain of $98,526, or 20.91 per cent. This is a product which seems destined to become a more important branch of the industry than at present, owing to its extended use in large buildings for both ornamental and sanitary purposes.

The fire-brick industry is one of great and growing importance. In 1903 the value of this product was $14,062,369, as compared with $12,601,435 in 1902, a gain of $1,460,934, or 11.59 per cent. It was second only to common brick in point of value, and it has increased in value of product $5,004,252, or 55.25 per cent, in five years. This product is consumed almost wholly in the iron and steel industries; it naturally follows the rise and fall of these articles; and, as in 1903, the largest production of iron and steel ever attained in the United States was made, the value of the fire brick of that year was also the largest in the history of the industry.

The drain-tile product increased in value from $3,506,787 in 1902 to $4,639,214 in 1903, a gain of $1,132,427, or 32.29 per cent. The gain in 1902 over 1901 was $363,786, or 11.57 per cent. The unusually wet seasons of 1902 and 1903 undoubtedly were responsible for this large increase. There seems, however, to be a growing confidence in the benefits of drainage in the middle West, which may be, in part, at least, responsible for this large increase in the drain-tile industry.

The sewer-pipe product is another that has made constant gains in recent years, going from $7,174,892 in 1902 to $8,525,369 in 1903, a gain of $1,350,477, or 18.82 per cent. The gain in 1902 over 1901 was $437,923, or 6.50 per cent. This product has steadily gained in value from $3,791,057 in 1898 to more than double that value, or $8,525,369, in 1903.

Ornamental terra cotta showed the largest proportional gain in value of any product, rising from $3,526,906 in 1902 to $4,672,028 in 1903, a gain of $1,145,122, or 32.47 per cent, thus attesting the popularity of this material. The use of glazed terra cotta in modern buildings in large cities where bituminous coal is the principal fuel is on the increase, as its merits as a building material are unquestioned.

Fireproofing, another material which finds its chief use in large buildings, is also gaining in popularity, as is shown by the large increase in 1903. The product in that year was valued at $3,861,343, as compared with $3,175,593 in 1902, a gain of $685,750, or 21.59 per cent. Recent large conflagrations have testified most forcibly to the great advantage of fireproof construction.

Although the product classed as tile (not drain), embracing floor, wall, and mantel tile, increased in 1902 over 1901, in 1903, as compared with 1902, there was a slight falling off, the value of the product dropping from $3,622,863 in 1902 to $3,505,329 in 1903, a loss of $117,534, or 3.24 per cent.

The brick and tile industry as a whole increased 7.63 per cent, or from $98,042,078 in 1902 to $105,526,596 in 1903, a gain of $7,484,518, and the pottery industry gained in the value of its product $1,308,599, or 5.42 per cent, the total gain for both branches of the industry being $8,793,117, or 7.20 per cent.

The following table shows the products of clay in the United States from 1894 to 1903, inclusive, 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, 1894–1903, by varieties.

Year.	Number of operating firms reporting.	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.*		
1894	....	6,152,420	$35,662,538	$5.70	(a)	(a)	....
1895	....	6,017,965	31,569,126	5.25	339,204	$4,399,367	$12.97
1896	5,298	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	3,855,053	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	6,046	8,475,067	48,885,869	5.77	458,391	5,318,008	11.60
1903	6,033	8,463,683	50,532,075	5.97	426,364	5,308,908	12.45

Year.	Vitrified paving brick. Quantity.	Vitrified paving brick. Value.	Vitrified paving brick. Average price per thousand.	Fancy or ornamental brick (value).	Enameled brick (value).	Fire brick (value).	Stove lining (value).	Drain tile (value).
	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
1903	654,499	6,453,849	9.86	322,567	569,689	d14,062,369	(d)	4,639,214

Year.	Sewer pipe (value).	Ornamental terra cotta (value).	Fireproofing (value).	Hollow building tile or blocks (value).	Tile, not drain (value).	Pottery (value).	Miscellaneous e (value).	Total value.
1894	$5,989,923	$1,476,185	$514,637	(f)	$1,688,724	(g)	$4,517,709	$64,655,885
1895	4,482,577	2,512,193	741,626	(f)	2,572,628	(g)	6,619,333	65,409,806
1896	4,588,508	2,359,983	1,706,504	(f)	1,618,127	$7,455,627	1,210,719	63,110,408
1897	4,069,534	1,841,422	1,979,259	(f)	1,476,638	10,309,209	1,413,595	62,359,991
1898	3,791,057	2,043,325	1,900,642	(f)	1,746,024	14,589,224	2,000,743	74,487,680
1899	4,560,334	2,027,532	1,665,066	(f)	1,276,300	17,250,250	6,065,928	95,797,370
1900	5,842,562	2,372,568	1,820,214	(f)	2,349,420	19,798,570	2,896,036	96,212,345
1901	6,736,969	3,367,982	1,860,269	(f)	2,867,659	22,463,860	2,945,268	110,211,587
1902	7,174,892	3,526,906	3,175,593	(f)	3,622,863	24,127,453	3,678,742	122,169,531
1903	8,525,369	4,672,028	2,708,143	$1,153,200	3,505,329	25,436,052	3,073,856	130,962,648

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 1898.
d Stove lining included in fire brick in 1903.
e Including pottery products in 1894 and 1895.
f Hollow building tile or blocks included in fireproofing prior to 1903.
g Pottery not separately classified in 1894 and 1895.

This table is interesting, inasmuch as it shows the industry for ten years, the period covered by the statistical canvass of this office. Almost all products have advanced in total value of output from 1897 (which was the year showing the lowest value since the beginning of the work) to 1903, the total value of the output being $62,359,991 in 1897, and $130,962,648 in 1903, a gain of $68,602,657, or 110 per cent. Brick and tile products have increased from $52,050,782 in 1897 to $105,526,596, a gain of $53,475,814, or 103 per cent. Pottery made still greater gains, from $10,309,209 in 1897 to $25,436,052, a gain of $15,126,843, or nearly 150 per cent. The number of common brick rose steadily, with the exception of 1900, from 5,292,532,000 in 1897 to 8,463,683,000 in 1903, while the value rose from $26,430,207 in 1897 to $50,532,075 in 1903, except in 1900, when this product was less in both output and value than in 1899. The average price per thousand ranged from $4.99 in 1897 to $5.97 in 1903. Vitrified paving brick has shown a steady growth from 1897 to 1903, and there seems to be no reason why this product should not grow in popularity, as it is a cheap and highly efficient paving material when properly laid, and should appeal to the small municipalities, and could even be used to advantage on country roads.

For the first time an attempt was made to get statistics of the fireproofing industry by itself. Heretofore the information under this head has included hollow building block or tile, terra cotta, lumber, etc. In 1903 the combined value of these products was $3,861,343, and the fireproofing alone was valued at $2,708,143. This fact should be borne in mind in making comparisons in this table.

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 1902 and 1903:

Rank of States, value of output, and percentage to total value of clay products in 1902 and 1903.

1903.

Rank.	State.	Number of operating firms reporting.	Value.	Per cent of total product.
1	Ohio	815	$25,208,128	19.25
2	Pennsylvania	523	18,847,324	14.39
3	New Jersey	159	13,416,939	10.24
4	Illinois	502	11,190,797	8.54
5	New York	242	9,208,252	7.03
6	Indiana	490	5,694,625	4.35
7	Missouri	242	5,661,607	4.32
8	Iowa	304	3,093,403	2.36
9	California	105	2,831,543	2.16
10	West Virginia	56	2,558,560	1.95
11	Kentucky	113	2,190,959	1.67
12	Massachusetts	86	2,108,685	1.61
13	Colorado	91	2,068,310	1.58
14	Minnesota	116	1,924,586	1.47
15	Maryland	59	1,908,821	1.46
16	Georgia	99	1,731,022	1.32
17	Michigan	178	1,710,421	1.31
18	Virginia	100	1,673,346	1.28
19	Kansas	56	1,487,004	1.14
20	Texas	168	1,472,580	1.12
21	Alabama	111	1,327,927	1.01
22	Wisconsin	158	1,307,396	1.00
23	Connecticut and Rhode Island	41	1,206,069	.92
24	Tennessee	110	1,186,516	.91
25	Washington	67	928,265	.71
26	North Carolina	195	862,496	.66
27	Louisiana	68	813,387	.62
28	Nebraska	100	768,255	.59
29	Maine	64	677,182	.52
30	Mississippi	85	677,082	.52
31	South Carolina	62	657,195	.50
32	Arkansas	59	589,946	.45
33	New Hampshire	34	568,621	.43
34	Utah	48	440,384	.34
35	Oregon	62	425,544	.32
36	Oklahoma	33	368,955	.28
37	District of Columbia	15	330,511	.25
38	Montana	24	329,317	.25
39	Florida	18	221,295	.17
40	Delaware	24	203,908	.16
41	Indian Territory	17	166,022	.13
42	Idaho	43	164,107	.13
43	New Mexico	14	142,039	.11
44	North Dakota	14	127,085	.10
45	Vermont	12	114,001	.09
46	Arizona	24	109,755	.08
47	Nevada	8	99,905	.08
48	South Dakota	12	68,825	.05
49	Wyoming	7	22,663	.02
	Other States		[a] 71,133	.05
	Total	6,033	130,962,648	100.00

[a] Includes pottery products which could not be separately classified without disclosing the operations of individual establishments.

Rank of States, value of output, and percentage to total value of clay products in 1902 and 1903—Continued.

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	111	1,901,781	1.56
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	359,006	.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	123,214	.10
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	6,046	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.

The following table shows the rank of the several States and Territories in the value of products of clay from 1894 to 1903:

Rank of clay-producing States, in value of products of clay, 1894–1903.

State.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Alabama	31	28	26	24	26	23	26	23	23	21
Arizona	46	47	43	41	40	44	42	42	43	46
Arkansas	34	33	34	35	34	34	33	34	32	32
California	16	10	21	21	12	12	14	11	11	9
Colorado	27	22	29	25	25	21	16	14	12	13
Connecticut [a]	20	20	11	10	16	20	20	21	21	23
Delaware	43	41	41	39	39	38	39	40	41	40
District of Columbia	28	27	28	30	30	33	35	35	37	37
Florida	40	39	39	38	38	41	40	39	39	39
Georgia	18	15	15	14	18	15	17	16	19	16
Idaho	44	44	46	46	47	45	44	46	44	42
Illinois	2	3	4	5	4	5	4	4	4	4
Indiana	6	6	7	6	6	6	6	7	6	6
Indian Territory	(b)	(b)	(b)	47	45	47	47	41	40	41
Iowa	8	9	9	9	8	8	8	8	8	8
Kansas	33	32	32	32	27	25	22	22	20	19
Kentucky	19	19	18	17	15	14	12	18	15	11
Louisiana	24	25	25	26	24	31	31	30	30	27
Maine	17	21	18	18	21	27	25	29	29	29
Maryland	11	13	10	11	10	11	11	13	13	15
Massachusetts	9	8	8	8	9	9	10	10	10	12
Michigan	10	11	12	19	14	15	18	17	16	17
Minnesota	15	12	20	15	11	18	13	15	14	14
Mississippi	38	36	33	31	31	32	30	33	33	30
Missouri	7	7	6	7	7	7	7	6	7	7
Montana	37	35	31	33	32	36	34	32	36	38
Nebraska	23	34	36	28	23	24	28	26	28	28
Nevada	....	....	....	....	....	48	49	49	48	47
New Hampshire	26	23	22	23	28	30	32	28	26	33
New Jersey	5	5	5	3	3	3	3	3	3	3
New Mexico	(b)	(b)	(b)	43	44	43	46	43	46	43
New York	4	4	3	4	5	4	5	5	5	5
North Carolina	30	26	24	27	29	26	24	27	27	26
North Dakota	42	42	42	40	42	39	43	45	42	44
Ohio	1	1	1	1	1	1	1	1	1	1
Oklahoma	[b] 41	[b] 43	[b] 45	44	41	41	38	38	38	36
Oregon [c]	36	37	38	37	37	35	36	37	35	35
Pennsylvania	3	2	2	2	2	2	2	2	2	2
Rhode Island	29	29	30	(a)	(a)	(a)	(a)	(a)	(a)	(a)
South Carolina	32	30	27	29	35	28	27	31	31	31
South Dakota	45	45	44	45	46	46	45	47	47	48
Tennessee	22	24	23	22	22	22	23	25	24	24
Texas	13	14	14	12	19	17	19	12	17	20
Utah	35	40	37	36	36	37	37	36	34	34
Vermont	39	38	40	42	43	42	41	44	45	45
Virginia	14	18	17	16	17	19	15	19	18	18
Washington	25	31	35	34	33	29	29	24	25	25
West Virginia	21	17	16	13	13	13	9	9	9	10
Wisconsin	12	16	19	20	20	10	21	20	22	22
Wyoming	47	46	47	48	48	49	48	48	49	49

[a] Rhode Island is included with Connecticut in 1897, 1898, 1899, 1900, 1901, 1902, and 1903.
[b] In 1894, 1895, and 1896 Indian Territory and New Mexico were included with Oklahoma Territory.
[c] Including Hawaii in 1901 and 1902.

From these tables it will be seen that though every State and Territory produces clay products in greater or less quantity, the leading producing States are located in the northern portion of the country from the Atlantic Ocean to the Missouri River. Hawaii, which has reported a product for several years, reported none for 1903.

Ohio has been the leading State in the production of the products of clay since the beginning of the canvass of the industry by this office. In 1903 the value of her clay products was $25,208,128, or 19.25 per cent of the total, as compared with $24,249,748, or 19.85 per cent of the total, in 1902. The number of operating firms reporting from Ohio showed a slight increase from 801 in 1902 to 815 in 1903. Pennsylvania maintained her standing as second, which she has held for nine years, with products valued at $18,847,324 in 1903, or 14.39 per cent of the total, as compared with $17,833,425, or 14.60 per cent of the total, in 1902.

New Jersey has been the third State in point of value of clay products for several years, and reported products valued at $13,416,939, or 10.24 per cent of the total, in 1903, as compared with $12,613,263, or 10.32 per cent of the total, in 1902. In fact, there has been no change in the relative standing of the States, all showing material increases, until ninth place is reached, which was occupied by California in 1903, with a product valued at $2,831,543, or 2.16 per cent of the product, displacing West Virginia, which occupied ninth place in 1902, with a product valued at $2,518,544. In 1902 California was eleventh, with a product valued at $2,253,096. The other changes of note are Kentucky, which rose from fifteenth place in 1902 to eleventh in 1903; Massachusetts, which fell from tenth to twelfth; Maryland, which fell from thirteenth to fifteenth; Georgia, which rose from nineteenth to sixteenth, regaining the place held by her in 1901; Louisiana, which rose from thirtieth to twenty-seventh; New Hampshire, which fell from twenty-sixth to thirty-third, and Texas, which fell from seventeenth to twentieth. The remaining States are unimportant so far as relative rank is concerned.

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 1902 and 1903, the former year being presented for comparative purposes only:

Brick and tile products of the United States in 1903.

State.	Common brick.			Front brick.		
	Quantity.	Value.	Average price per thousand.	Quantity.	Value.	Average price per thousand.
	Thousands.			*Thousands.*		
Alabama	156,475	$913,911	$5.84	765	$6,155	$8.05
Arizona	15,148	109,699	7.24	....	....	....
Arkansas	78,598	553,716	7.04	1,115	11,020	9.88
California	217,715	1,600,882	7.35	8,886	229,587	25.83
Colorado	132,733	898,566	6.78	26,341	281,929	10.70
Connecticut and Rhode Island	158,382	890,989	5.62	(a)	(a)	15.04
Delaware	21,552	188,058	8.73	700	12,650	18.07
District of Columbia	31,062	236,883	7.62	(a)	(a)	15.24
Florida	36,529	218,086	5.94	....	....	....
Georgia	257,844	1,305,896	5.06	2,915	25,748	8.83
Idaho	19,887	148,217	7.45	450	5,950	13.22
Illinois	1,015,541	5,388,589	5.31	25,122	274,723	10.93
Indiana	294,890	1,697,190	5.76	24,742	232,487	9.36
Indian Territory	23,499	153,722	6.54	(a)	(a)	13.33
Iowa	191,323	1,355,129	7.08	12,815	135,849	10.60
Kansas	141,935	706,010	4.97	14,259	118,561	8.31
Kentucky	123,309	689,403	5.59	6,869	53,769	7.83
Louisiana	111,105	689,187	6.20	(a)	(a)	12.44
Maine	61,244	407,214	6.65	3,616	33,000	9.13
Maryland	147,663	976,969	6.62	2,728	40,479	14.84
Massachusetts	190,812	1,236,103	6.48	2,625	52,450	19.98
Michigan	215,791	1,251,572	5.80	2,225	19,000	8.54
Minnesota	161,911	982,728	6.07	6,922	78,930	11.40
Mississippi	109,217	658,491	6.03	(a)	(a)	11.98
Missouri	274,755	1,725,253	6.28	26,153	333,965	12.77
Montana	25,396	197,604	7.78	(a)	(a)	24.52
Nebraska	106,615	710,399	6.66	1,552	17,450	11.24
Nevada	9,454	83,405	8.82	890	16,500	18.53
New Hampshire	86,614	546,172	6.30	(a)	(a)	15.47
New Jersey	272,178	1,500,295	5.51	41,075	548,553	13.35
New Mexico	16,098	102,246	6.35	2,530	30,357	11.99
New York	1,068,464	5,305,522	4.96	18,383	248,760	13.53
North Carolina	136,493	728,802	5.33	765	8,223	10.74
North Dakota	14,825	116,547	7.86	(a)	(a)	13.73
Ohio	497,071	3,002,506	6.04	50,997	633,101	12.41
Oklahoma	47,796	347,755	7.27	(a)	(a)	8.00
Oregon	32,216	249,178	7.73	1,625	42,375	26.07
Pennsylvania	927,212	6,174,437	6.66	80,177	1,050,805	13.11
South Carolina	124,759	612,968	4.91	300	2,800	9.33
South Dakota	7,818	63,875	8.17	(a)	(a)	20.00
Tennessee	129,818	789,111	6.08	3,429	35,965	10.49
Texas	178,134	1,074,051	6.03	5,462	65,628	12.02
Utah	44,867	265,553	5.92	12,191	111,825	9.17
Vermont	13,907	88,801	6.39	....	....	....
Virginia	189,891	1,245,861	6.56	18,866	303,431	16.08
Washington	72,825	557,147	7.65	3,421	65,755	19.22
West Virginia	88,060	576,404	6.55	269	3,356	12.48
Wisconsin	181,722	1,193,360	6.57	6,794	62,857	9.25
Wyoming	2,531	22,663	8.95	....	....	....
Other States (b)	....	....	....	8,390	114,965	13.70
Total	8,463,683	50,532,075	5.97	426,364	5,308,908	12.45
Per cent of brick and tile products	....	47.88	....	....	5.03	....
Per cent of total of clay products	....	38.58	....	....	4.05	....

(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.

Brick and tile products of the United States in 1903—Continued.

State.	Vitrified brick.			Fancy or ornamental brick (value).	Fire brick (value).	Draintile (value).	Sewer pipe (value).
	Quantity.	Value.	Average price per thousand.				
	Thousands.						
Alabama	(a)	(a)	$8.85	(a)	$297,985	$418	(a)
Arkansas	(a)	(a)	8.50	(a)	9,850	1,650	....
California	(a)	(a)	15.00	(a)	200,332	17,994	$411,3[illegible]
Colorado	2,477	$25,824	10.43	$4,618	631,074	3,000	(a)
Connecticut and Rhode Island	(a)	(a)	14.68	(a)	61,500	....	....
Delaware	....	....	....	....	....	(a)	....
District of Columbia	....	....	....	(a)	....	(a)	54,500
Florida	....	....	....	....	(a)	(a)	....
Georgia	(a)	(a)	10.93	2,100	73,600	(a)	162,068
Idaho	(a)	(a)	20.00	....	(a)	....	(a)
Illinois	96,568	1,015,710	10.52	12,927	233,106	892,807	532,856
Indiana	47,864	482,967	10.09	(a)	115,526	1,014,706	363,212
Indian Territory	....	....	....	....	(a)	....	....
Iowa	21,888	232,510	10.62	(a)	975	1,028,383	(a)
Kansas	54,061	430,744	7.96	(a)	(a)	24,265	(a)
Kentucky	(a)	(a)	15.20	....	873,294	20,621	(a)
Maine	(a)	(a)	14.96	....	(a)	2,327	(a)
Maryland	(a)	(a)	9.46	(a)	272,296	1,355	....
Massachusetts	....	....	....	(a)	200,225	....	....
Michigan	(a)	(a)	13.27	(a)	(a)	129,028	(a)
Minnesota	195	1,875	9.62	(a)	....	10,067	(a)
Mississippi	....	....	....	....	....	2,620	....
Missouri	31,496	307,237	9.75	39,756	925,915	45,363	1,050,794
Montana	(a)	(a)	18.00	....	101,700	(a)	(a)
Nebraska	4,300	35,700	8.30	....	....	....	....
New Hampshire	....	....	....	....	(a)	....	....
New Jersey	1,402	22,195	15.83	14,970	949,392	20,825	(a)
New Mexico	(a)	(a)	9.24	(a)	(a)	....	....
New York	16,797	220,296	13.11	(a)	629,245	140,181	134,360
North Carolina	(a)	(a)	10.00	....	5,250	5,989	(a)
North Dakota	....	....	....	(a)	(a)	....	....
Ohio	202,649	1,860,071	9.17	42,522	1,561,986	1,149,990	3,295,635
Oklahoma	(a)	(a)	9.00	....	....	....	....
Oregon	....	....	....	....	(a)	23,331	(a)
Pennsylvania	72,039	685,274	9.51	32,602	6,537,076	11,451	727,465
South Carolina	....	....	....	(a)	27,240	(a)	....
South Dakota	(a)	(a)	15.00	....	(a)	....	....
Tennessee	(a)	(a)	8.85	22,696	50,585	18,509	(a)
Texas	(a)	(a)	9.53	11,240	22,333	(a)	(a)
Utah	....	....	....	(a)	28,150	(a)	(a)
Vermont	....	....	....	....	(a)	(a)	....
Virginia	(a)	(a)	8.92	27,830	54,171	4,750	....
Washington	4,555	67,314	14.78	(a)	13,932	10,883	171,133
West Virginia	51,762	576,258	11.13	....	70,802	1,499	(a)
Wisconsin	(a)	(a)	12.00	(a)	....	34,556	....
Other States[b]	46,446	489,874	10.55	111,806	114,880	27,626	1,621,964
Total	654,499	6,453,849	9.86	[c] 892,256	14,062,369	4,639,214	8,525,369
Per cent of brick and tile products	....	6.12	....	.84	13.33	4.40	8.08
Per cent of total of clay products	....	4.93	....	.68	10.74	3.54	6.51

[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.
[c] Including enameled brick valued at $569,689, made in the following States: California, Illinois, Maryland, Missouri, New Jersey, Ohio, and Pennsylvania. New Jersey and Ohio, with products, respectively, of $213,463 and $32,552, were the only States in which there were three or more producers of enameled brick.

Brick and tile products of the United States in 1903—Continued.

State.	Ornamental terra cotta (value).	Fireproofing (value).	Hollow building tile or blocks (value).	Tile, not drain (value).	Miscellaneous (value).a	Total value.
Alabama				(b)		$1,304,607
Arizona					$56	109,755
Arkansas						578,346
California	$180,488	$61,649	(b)	(b)	27,976	2,782,065
Colorado		(b)			49,000	2,011,441
Connecticut and Rhode Island		(b)	(b)			1,093,619
Delaware						203,908
District of Columbia		(b)			16,243	319,657
Florida						221,295
Georgia	85,500	(b)	(b)		1,069	1,708,880
Idaho					120	164,107
Illinois	1,196,477	308,561	$27,277	$283,426	4,498	10,291,064
Indiana	(b)	(b)	162,172	463,082	358,511	5,113,656
Indian Territory					7,500	166,022
Iowa			131,191	(b)	63,904	3,037,641
Kansas			(b)	(b)	27,099	1,463,475
Kentucky		(b)		222,420		2,051,132
Louisiana					73,200	813,387
Maine						677,182
Maryland	(b)			(b)	27,360	1,435,566
Massachusetts	(b)	(b)		(b)	2,778	1,807,849
Michigan	(b)		19,188			1,662,414
Minnesota		(b)	50,500		160	1,527,008
Mississippi					200	662,737
Missouri	371,006	91,583	7,355	235,091	409,355	5,610,206
Montana		(b)	(b)	(b)		329,317
Nebraska					4,706	768,255
Nevada						99,905
New Hampshire						568,621
New Jersey	1,364,094	1,256,002	69,652	734,159	407,054	7,101,713
New Mexico					800	142,039
New York	947,153	(b)	28,825	150,504	46,450	7,934,174
North Carolina					5,000	848,264
North Dakota						127,085
Ohio	(b)	347,105	518,544	1,072,103	598,686	14,120,041
Oklahoma					15,000	368,955
Oregon		(b)	(b)		12,000	425,544
Pennsylvania	329,004	191,890	86,731	207,608	847,470	16,973,772
South Carolina		(b)				647,368
South Dakota						68,825
Tennessee		(b)	(b)			1,072,342
Texas				(b)	65,500	1,374,914
Utah					150	435,084
Vermont						114,001
Virginia					160	1,650,660
Washington	(b)	(b)	(b)		651	912,165
West Virginia	(b)			(b)		1,310,060
Wisconsin			(b)		1,200	1,293,810
Wyoming						22,663
Other States c	196,306	451,408	51,815	136,936		(d)
Total	4,672,028	2,708,143	1,158,200	3,505,329	3,073,856	105,526,596
Per cent of brick and tile products	4.43	2.57	1.09	3.32	2.91	100.00
Per cent of total of clay products	3.57	2.07	.88	2.68	2.35	80.58

a Including adobes, aquarium ornaments, assayers' furnaces, boiler and locomotive tile and tank blocks, burnt-clay ballast, carboy stoppers, chemical brick, chimney radial brick, pipe, and tops; clay furnaces, retorts, and settings; crucibles, cupola lining, curbing blocks, electrical conduits, fire mortar, flue lining, gas logs, glass-house supplies, grave markers, muffles, oven tile, paving block, runner brick, saggers, scarifiers, sectional sewer blocks, stone pumps, tunnel and well brick, and wall coping conduits.

b Included in Other States.

c Includes all products made by less than three producers in one State in order that the operations of individual establishments may not be disclosed.

d 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 1902.

State.	Common brick.			Front brick.		
	Quantity.	Value.	Average price per thousand.	Quantity.	Value.	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)	9.00
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	306,233	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	192,674	1,103,515	5.72	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	131,816	692,813	5.28	995	8,375	8.42
North Dakota	16,356	113,022	6.91	(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	9,442	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 of 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	8,250	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	822,250	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	894,718
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					29,800	(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	362,518	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).a	Total value.
Alabama				(b)	$500	$989,865
Arizona					28	114,606
Arkansas				(b)	10,187	510,728
California	$881,076	$178,194	$18,645	(b)	49,001	2,201,489
Colorado	(b)		(b)	(b)	72,304	2,166,668
Connecticut and Rhode Island			(b)			1,100,781
Delaware						144,984
District of Columbia	37,820		(b)		25,000	258,490
Florida	(b)					175,442
Georgia	174,006	91,000	21,650			1,491,830
Idaho					180	98,048
Illinois	360,149	1,000,765	358,015	$257,049	22,403	9,187,426
Indiana	311,223	(b)	342,854	579,896	92,556	4,628,449
Indian Territory						167,674
Iowa	(b)	(b)	103,824	2,590	51,157	2,797,949
Kansas	(b)		(b)		31,449	1,221,588
Kentucky	(b)			237,469		1,736,000
Louisiana					23,571	642,424
Maine	(b)					656,648
Maryland	(b)	(b)		(b)	31,318	1,880,062
Massachusetts		(b)	(b)	67,418	9,015	2,075,212
Michigan	(b)		3,290	(b)		1,660,942
Minnesota	(b)	(b)	41,000	(b)	360	1,531,006
Mississippi						501,786
Missouri	903,279	(b)	99,690	103,856	430,544	5,112,901
Montana	(b)				11,083	278,727
Nebraska						757,608
Nevada						45,600
New Hampshire						887,124
New Jersey	(b)	861,780	965,047	795,153	649,139	6,420,304
New Mexico					480	68,879
New York	209,105	(b)	123,497	125,680	106,825	7,484,682
North Carolina	(b)		(b)			781,069
North Dakota						123,214
Ohio	2,646,134	18,289	757,618	1,156,371	1,279,471	13,730,610
Oklahoma						235,975
Oregon c	(b)		3,315		45	318,604
Pennsylvania	550,481	243,800	138,839	232,431	749,502	15,957,169
South Carolina						596,706
South Dakota						63,425
Tennessee	(b)		(b)			862,427
Texas	(b)			(b)	6,665	1,596,612
Utah	(b)				878	353,255
Vermont					d 18,000	78,886
Virginia			(b)			1,573,842
Washington	118,462	35,225		(b)	5,161	891,877
West Virginia	(b)			(b)	500	1,352,069
Wisconsin				(b)	1,120	1,014,873
Wyoming					e 350	22,150
Other States f	1,483,155	1,102,908	196,314	65,450		(g)
Total	7,174,892	3,526,906	3,175,598	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 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.

b Included in Other States.

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.

These tables show in detail the brick and tile products of the country as classified by this Office in the two years of greatest prosperity the industry has ever known, when the products shown were valued at $105,526,596 and $98,042,078 in 1903 and 1902, respectively. This was a gain in 1903 of $7,484,518, or 7.63 per cent. The corresponding increase in 1902 over 1901 was $10,294,351, or 11.73 per cent. These products composed 80.58 per cent of the total in 1903 and 80.25 per cent in 1902. The number of common brick reported in 1903 was 8,463,683,000, as compared with 8,475,067,000 in 1902, a decrease of 11,384,000. The average price per thousand of this class of brick increased from $5.77 in 1902 to $5.97 in 1903. The value of the common-brick product in 1903 was 47.88 per cent of all brick and tile products and 38.58 per cent of the value of all clay products. In 1902 these percentages were 49.86 and 40.01, respectively.

The next most important product in point of value was fire brick (including stove lining), which was valued in 1903 at $14,062,369, or 13.33 per cent of the brick and tile products and 10.74 per cent of the all-clay products. In 1902 this product was valued at $12,601,435, or 12.85 per cent of the brick and tile products and 10.32 per cent of the total clay products.

The sewer-pipe industry is one of importance, this product ranking third in point of value in 1903, when it was valued at $8,525,369, or 8.08 per cent of the brick and tile products and 6.51 per cent of all clay products.

The vitrified paving brick was fourth in value, being in 1903 valued at $6,453,849, as compared with $5,744,530 in 1902. The quantity increased from 617,192,000 in 1902 to 654,499,000 in 1903, and the average value per thousand increased from $9.31 in 1902 to $9.86 in 1903.

Fireproofing apparently fell off in 1903, but this is only apparent, as for 1903 it was reported separately, whereas in previous years hollow building block or tile, etc., have been included with it.

RANK OF STATES.

The following tables show the rank of States in the output of brick nd tile products as distinguished from pottery products and the per-centage of the total made by each State and Territory in 1902 and 1903.

Rank of States, value of output, and percentage of total brick and tile products in 1902 and 1903.

1903.

Rank.	State.	Value.	Per cent of total product.
1	Pennsylvania	$16,973,772	16.09
2	Ohio	14,120,041	13.38
3	Illinois	10,291,064	9.75
4	New York	7,934,174	7.52
5	New Jersey	7,101,713	6.73
6	Missouri	5,610,206	5.32
7	Indiana	5,113,656	4.84
8	Iowa	3,037,641	2.88
9	California	2,782,065	2.64
10	Kentucky	2,051,132	1.94
11	Colorado	2,011,441	1.91
12	Massachusetts	1,807,849	1.71
13	Georgia	1,708,880	1.62
14	Michigan	1,662,414	1.58
15	Virginia	1,650,660	1.56
16	Minnesota	1,527,008	1.45
17	Kansas	1,463,475	1.39
18	Maryland	1,435,566	1.36
19	Texas	1,374,914	1.30
20	West Virginia	1,310,060	1.24
21	Alabama	1,304,607	1.24
22	Wisconsin	1,293,810	1.23
23	Connecticut and Rhode Island	1,093,619	1.04
24	Tennessee	1,072,342	1.02
25	Washington	912,165	.86
26	North Carolina	848,264	.80
27	Louisiana	813,387	.77
28	Nebraska	768,255	.73
29	Maine	677,182	.64
30	Mississippi	662,737	.63
31	South Carolina	647,368	.61
32	Arkansas	578,346	.55
33	New Hampshire	568,621	.54
34	Utah	435,084	.41
35	Oregon	425,544	.40
36	Oklahoma	368,955	.35
37	Montana	329,317	.31
38	District of Columbia	319,657	.30
39	Florida	221,295	.21
40	Delaware	203,908	.19
41	Indian Territory	166,022	.16
42	Idaho	164,107	.16
43	New Mexico	142,089	.13
44	North Dakota	127,065	.12
45	Vermont	114,001	.11
46	Arizona	109,755	.10
47	Nevada	99,905	.09
48	South Dakota	68,825	.07
49	Wyoming	22,668	.02
	Total	105,526,596	100.00

Rank of States, value of output, and percentage to total of brick and tile products in 1902 and 1903.

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	1,531,006	1.56
17	Georgia	1,491,830	1.52
18	Maryland	1,380,062	1.41
19	West Virginia	1,352,090	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	123,214	.12
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.

Ohio is the leading State in the value of all clay products, but took second place in the production of brick and tile products in 1903, Pennsylvania producing these materials to the value of $16,973,772, or 16.09 per cent of the total, compared with Ohio's production of $14,120,041, or 13.38 per cent of the total. This is accounted for by the large output of building and fire brick in Pennsylvania, while Ohio's chief brick and tile products are vitrified paving brick, drain tile, sewer pipe, fireproofing, and floor, wall, and art tiles. Ohio's leading position with regard to the total value of all clay products is due to the large pottery output. The other leading States maintained their relative positions during 1902 and 1903.

HUDSON RIVER REGION.

The following table shows the production of common brick along the Hudson River from Cohoes, N. Y., to New York City, including Bergen County, N. J. This region continues to be the most important common-brick making region probably in the world, and is the principal source of supply for the New York market, the largest in the United States. New York State continues to be the largest producer of common brick in the United States, marketing 1,068,464,000 in 1903. Of this quantity 798,254,000, or 74.71 per cent, were produced along the Hudson River, as compared with 782,932,000, or 73.74 per cent, in 1902, a gain of 15,322,000, or 1.96 per cent.

This output of common brick was exceeded by only two States in the Union, Illinois and Pennsylvania, Ohio producing a little less than two-thirds as much as the New York portion of this region. No other State produced even as much as 40 per cent of the New York portion, Indiana being the largest producer, with only 36.94 per cent. Ulster County had the largest output, 190,981,000, and Rensselaer the smallest, 17,504,000. There were only 10 States besides New York that marketed more common brick than Ulster County, namely: California, 217,715,000; Georgia, 257,844,000; Illinois, 1,015,541,000; Indiana, 294,890,000; Iowa, 191,323,000; Michigan, 215,791,000; Missouri, 274,755,000; New Jersey, 272,178,000; Ohio, 497,071,000, and Pennsylvania, 927,212,000.

Of New Jersey's output of 272,178,000 common brick, one county, Bergen, included in this table, produced 46,246,000, or a little more than one-sixth of the total. The market for the brick of this county is found almost wholly in Greater New York, hence this county was perhaps more seriously affected by the building strikes in 1903 in that city than any other part of the region, which may account for its falling off. The average price per thousand ranged from $4.01 in Ulster County to $5.57 in Orange County, the average for the New York portion being $4.69 as compared with $4.42 in 1902. The average value per thousand in Bergen County, N. J., in 1903 was $5 as compared with $4.38 in 1902. The average for the whole region was $4.70 in 1903 as compared with $4.42 in 1902.

As heretofore, the figures embraced in this table include principally the output made along the river, which is shipped mostly to Greater New York, though of course there is more or less local consumption, especially in the northernmost counties.

Production of common brick in the Hudson River district, from Cohoes to New York City, in 1902 and 1903, by counties.

1903.

County.	Number of firms reporting.	Quantity.	Value.	Average price per thousand.
		Thousands.		
Albany	8	46,000	$244,851	$5.32
Columbia	5	57,382	243,707	4.25
Dutchess	17	143,462	667,455	4.65
Greene	4	28,225	122,625	4.34
Orange	7	80,945	450,663	5.57
Rensselaer	7	17,504	85,323	4.87
Rockland	29	184,255	921,511	5.00
Ulster	23	190,981	765,504	4.01
Westchester	7	49,500	240,264	4.85
Total for New York	107	798,254	3,741,903	4.69
Bergen County, N. J	8	46,246	231,413	5.00
Total	115	844,500	3,973,316	4.70

1902.

County.	Number of firms reporting.	Quantity.	Value.	Average price per thousand.
		Thousands.		
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 1902 and 1903, by States and Territories:

Average value per thousand of various kinds of brick in 1903, by States and Territories.

COMMON BRICK.

Wyoming	$8.95	New Hampshire	$6.30
Nevada	8.82	Missouri	6.28
Delaware	8.73	Louisiana	6.20
South Dakota	8.17	Tennessee	6.08
North Dakota	7.86	Minnesota	6.07
Montana	7.78	Ohio	6.04
Oregon	7.73	Mississippi	6.03
Washington	7.65	Texas	6.03
District of Columbia	7.62	Rhode Island	6.00
Idaho	7.45	Florida	5.94
California	7.35	Utah	5.92
Oklahoma	7.27	Alabama	5.84
Arizona	7.24	Michigan	5.80
Iowa	7.08	Indiana	5.76
Arkansas	7.04	Kentucky	5.59
Colorado	6.73	Connecticut	5.57
Nebraska	6.66	New Jersey	5.51
Pennsylvania	6.66	North Carolina	5.33
Maine	6.65	Illinois	5.31
Maryland	6.62	Georgia	5.06
Wisconsin	6.57	Kansas	4.97
Virginia	6.56	New York	4.96
West Virginia	6.55	South Carolina	4.91
Indian Territory	6.54		
Massachusetts	6.48	Average for the United States	5.97
Vermont	6.39		
New Mexico	6.35		

FRONT BRICK.

Oregon	$26.07	New Mexico	$11.99
California	25.83	Mississippi	11.96
Montana	24.52	Minnesota	11.40
Connecticut	23.00	Nebraska	11.24
South Dakota	20.00	Illinois	10.93
Massachusetts	19.98	North Carolina	10.74
Washington	19.22	Colorado	10.70
Nevada	18.53	Iowa	10.60
Delaware	18.07	Tennessee	10.49
Virginia	16.08	Arkansas	9.88
New Hampshire	15.47	Indiana	9.36
District of Columbia	15.24	South Carolina	9.33
Rhode Island	15.00	Wisconsin	9.25
Maryland	14.84	Utah	9.17
North Dakota	13.73	Maine	9.13
New York	13.53	Georgia	8.83
New Jersey	13.35	Michigan	8.54
Indian Territory	13.33	Kansas	8.31
Idaho	13.22	Alabama	8.05
Pennsylvania	13.11	Oklahoma	8.00
Missouri	12.77	Kentucky	7.83
West Virginia	12.48		
Louisiana	12.44	Average for the United States	12.45
Ohio	12.41		
Texas	12.02		

VITRIFIED PAVING BRICK.

Idaho	$20.00	North Carolina	$10.00
Montana	18.00	Missouri	9.75
New Jersey	15.83	Minnesota	9.62
Kentucky	15.20	Texas	9.53
California	15.00	Pennsylvania	9.51
South Dakota	15.00	Maryland	9.46
Maine	14.96	New Mexico	9.24
Washington	14.78	Ohio	9.17
Michigan	13.27	Oklahoma	9.00
New York	13.11	Virginia	8.92
Wisconsin	12.00	Alabama	8.85
West Virginia	11.13	Tennessee	8.85
Georgia	10.93	Arkansas	8.50
Iowa	10.62	Nebraska	8.30
Illinois	10.52	Kansas	7.96
Colorado	10.43		
Rhode Island	10.43	Average for the United States	9.86
Indiana	10.09		

Average value per thousand of various kinds of brick in 1902, by States and Territories.

COMMON BRICK.

Hawaii	$14.40	Maryland	$6.23
Nevada	8.70	Texas	6.22
Wyoming	8.56	Virginia	6.16
Delaware	8.28	Wisconsin	6.05
Washington	7.87	Louisiana	6.04
South Dakota	7.83	Utah	5.93
Oregon	7.44	Kentucky	5.85
Idaho	7.42	Mississippi	5.79
District of Columbia	7.40	Ohio	5.74
Arizona	7.30	Minnesota	5.72
Oklahoma	7.20	Tennessee	5.72
California	7.14	Alabama	5.71
Montana	7.13	Vermont	5.63
Iowa	6.91	Michigan	5.61
North Dakota	6.91	Indiana	5.60
Rhode Island	6.88	Connecticut	5.58
New Hampshire	6.87	Florida	5.39
Colorado	6.70	North Carolina	5.28
Indian Territory	6.57	Kansas	5.24
Arkansas	6.52	Illinois	5.01
West Virginia	6.50	New Jersey	5.01
New Mexico	6.40	Georgia	4.98
Pennsylvania	6.40	South Carolina	4.76
Maine	6.38	New York	4.73
Massachusetts	6.34		
Nebraska	6.34	Average for the United States	5.77
Missouri	6.27		

FRONT BRICK.

Oregon	$28.70	New Hampshire	$10.87
Connecticut	23.00	Iowa	10.76
Washington	21.57	Texas	10.76
Nevada	20.00	Ohio	10.57
California	19.56	Colorado	10.53
Massachusetts	19.07	Tennessee	10.31
South Dakota	17.67	Mississippi	10.21
Montana	17.43	Idaho	10.00
Virginia	16.84	Louisiana	10.00
West Viginia	14.33	Maine	10.00
District of Columbia	14.17	New Mexico	10.00
Delaware	14.03	Arkansas	9.13
Wyoming	14.00	Wisconsin	9.10
North Dakota	13.40	Georgia	9.04
New York	13.16	Rhode Island	9.00
Nebraska	13.15	Utah	9.00
Maryland	13.13	Kansas	8.91
New Jersey	12.86	Indiana	8.65
Pennsylvania	12.43	North Carolina	8.42
Minnesota	12.08	Kentucky	7.62
Oklahoma	12.00	Michigan	7.53
Missouri	11.65	South Carolina	6.96
Alabama	11.63		
Illinois	11.48	Average for the United States	11.60
Indian Territory	11.24		

VITRIFIED PAVING BRICK.

Maine	$19.99	West Virginia	$9.56
Washington	15.81	Pennsylvania	9.43
Maryland	15.51	Texas	9.23
Montana	15.00	Illinois	9.22
Kentucky	13.80	Rhode Island	9.10
Michigan	12.26	Arkansas	9.00
New York	11.93	Oklahoma	9.00
Colorado	11.57	Ohio	8.80
Alabama	11.00	Missouri	8.72
Tennessee	10.49	New Mexico	7.75
New Jersey	10.29	Nebraska	7.74
Louisiana	10.00	Kansas	7.52
North Carolina	10.00		
Iowa	9.71	Average for the United States	9.31
Indiana	9.61		

Hawaii, which had the highest priced common brick in 1901 and 1902, reported no product in 1903, leaving Wyoming the State in which the highest average price was attained, namely, $8.95 per thousand, but as the production was small it had little effect on the general average. The average price of this variety of brick in this State in 1902 was $8.56. Nevada was second with common brick, valued at $8.82 per thousand. Delaware was third with an average of $8.73 in 1903 and fourth in 1902 with an average of $8.28. As in 1902, the highest average prices prevailed in the far western States, except in Delaware and the District of Columbia, where prices seem to range abnormally high for the eastern part of the country. South Carolina, New York, and Kansas appear to be the States in which the average price was lowest, being $4.91, $4.96, and $4.97, respectively. In Rhode Island and Florida the average most nearly approached the average for the country.

Front brick ranged in value from $26.07 per thousand in Oregon to $7.83 in Kentucky, Louisiana, with an average value of $12.44, being the nearest to the general average, $12.45. In 1902 the average ranged from $28.70 in Oregon to $6.96 in South Carolina, with Alabama the nearest to the general average of $11.60, the average in that State being $11.63.

Vitrified paving brick ranged in value from $20 per thousand in Idaho to $7.96 in Kansas. In Ohio, the largest producer of this variety of brick, the average per thousand was $9.17, and in Pennsylvania, the next largest producer, $9.51, while in Illinois the average was $10.52. Missouri was the nearest to the general average of $9.86, her product being valued at $9.75. In 1902 the prices ranged from $19.99 per thousand in Maine to $7.52 in Kansas, Texas coming the nearest to the general average of $9.31 with a value of $9.23 per thousand.

POTTERY.

INTRODUCTION.

The year 1903 should have been a satisfactory one to the potters of the United States as a whole, inasmuch as the total value of the product marketed showed an increase, but to some of the white-ware manufacturers the year's business was not so good as in 1902. This was especially true of the so-called western potters—those located west of the Alleghany Mountains, where quite a considerable number of new potteries were added to the list, and although some of them did not actively enter the market in 1903, the fact that they were about to become competitors, coupled with the large increase in imports, seemed to unsettle the market and materially to reduce the output of many of the leading potters of the western region.

The total value of the product increased from $24,127,453 in 1902 to $25,436,052 in 1903, a gain of $1,308,599, or 5.42 per cent. This gain, while not so large as that of 1902 over 1901 or 1901 over 1900, when the increases were $1,663,593, or 7.41 per cent, and $2,665,290, or 13.46 per cent, respectively, shows that the industry is more than holding its own, and that although the prosperity of the industry may not have been as great, comparatively, as in 1902, nevertheless it is in a healthy condition. The number of operating firms reporting increased from 518 in 1902 to 546 in 1903, a gain of 28, or 5.41 per cent.

Ohio and Pennsylvania, where the new white-ware potteries have been established, showed a gain of 21 establishments, or an increase of 13.13 per cent, although the output of these two States increased only 4.57 per cent.

Another notable feature of the year was the large increase of the imports. The pottery imports increased from $9,570,534 in 1902 to $11,227,701 in 1903, a gain of $1,657,167, or 17.32 per cent, as compared with a gain of 5.42 per cent in domestic production. This is the largest value for imported pottery ever recorded. The next largest was in 1895, when it was $10,234,322.

PRODUCTION.

The following tables show the value of the pottery products of the United States, by varieties of products and by States and Territories, in 1902 and 1903:

Value of pottery products, by varieties of products in 1903, by States and Territories.

PLAIN.

State.	Red earthenware.	Stoneware.	Yellow and rockingham ware.	C. C. ware.	White granite, semiporcelain ware, and semivitreous porcelain ware.	China.
Alabama	$1,216	$22,104				
Arkansas	(a)	9,400				
California	27,882	9,858				
Colorado	6,264	(a)	(a)			
Connecticut	18,550	(a)				
District of Columbia	10,854					
Georgia	3,972	17,970				
Illinois	27,685	662,363	(a)	(a)	(a)	
Indiana	9,700	63,460			(a)	
Iowa	4,300	48,622				
Kansas		23,529				
Kentucky	19,207	120,620				
Louisiana	(a)					
Maine		(a)				
Maryland	14,928		(b)		$161,000	
Massachusetts	111,542	26,840		(c)		
Michigan	42,007					
Minnesota	9,718	385,995				
Mississippi	580	13,715				
Missouri	6,697	43,304				
Montana	(a)					
New Jersey	14,500	50,404	(b)	$409,029	386,984	$371,900
New York	29,959	52,351	(a)	(a)	(a)	(a)
North Carolina	612	13,620				
Ohio	94,591	960,623	$222,904	419,639	2,676,069	166,540
Oregon	(a)	(a)				
Pennsylvania	183,391	393,494	(a)		286,398	(a)
South Carolina	2,840	6,987				
Tennessee	(a)	92,415				
Texas	6,789	89,347	(a)	(a)		
Utah	5,300					
Vermont	(a)					
Virginia	(a)	(a)	(a)			
Washington	(a)	14,100				
West Virginia		16,600		(a)	303,200	
Wisconsin	12,386					
Other States[d]	21,290	47,398	102,790	128,092	212,764	311,712
Total plain	631,760	3,185,119	325,694	956,760	4,026,365	850,152

DECORATED.

State.	Red earthenware.	Stoneware.	Yellow and rockingham ware.	C. C. ware.	White granite, semiporcelain ware, and semivitreous porcelain ware.	China.
Colorado	(e)					
Illinois	(a)	(a)		(a)	(a)	
Maryland	(e)				$289,000	
Massachusetts	(e)					
New Jersey	(a)			(a)	1,188,968	$433,791
Ohio	$28,970	$141,551		$342,836	4,005,011	95,760
Pennsylvania	5,150	(a)			749,796	(a)
West Virginia					750,878	
Other States[d]	32,295	6,472		52,500	130,908	306,799
Total decorated	66,415	148,023		395,336	7,114,561	836,350
Grand total	698,175	3,333,142	$325,694	1,352,096	11,140,916	1,686,502
Per cent of total clay products	.53	2.54	.25	1.03	8.51	1.29
Per cent of pottery products	2.74	13.10	1.28	5.32	43.80	6.63

a Included in Other States.

b Yellow and Rockingham ware for Maryland and New Jersey are included in the miscellaneous column of each of these States.

c C. C. ware for Massachusetts included in Massachusetts 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 totals.

e Decorated earthenware for Colorado, Maryland, and Massachusetts included in the miscellaneous columns of each of these States.

Value of pottery products, by varieties of products in 1903, by States and Territories—Continued.

PLAIN.

State.	Bone china, delft, and belleek ware.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.
Alabama					$23,320
Arkansas					11,600
California		(b)		$11,738	49,478
Colorado				112	33,230
Connecticut			(c)	19,000	77,250
District of Columbia					10,854
Georgia				200	22,142
Illinois				10,600	826,914
Indiana		(c)	(c)		510,658
Iowa				2,840	55,762
Kansas					23,529
Kentucky					189,827
Louisiana					(d)
Maine					(d)
Maryland				6,827	182,755
Massachusetts				75,923	214,805
Michigan				6,000	48,007
Minnesota					395,713
Mississippi					14,295
Missouri			(e)	600	50,601
Montana					(d)
New Hampshire				(c)	(d)
New Jersey	$71,000	$2,774,484	$385,398	126,828	4,590,477
New York		(c)	474,842	38,731	981,636
North Carolina					14,232
Ohio		(b)	486,740	786,024	5,813,130
Oregon					(d)
Pennsylvania		144,414		5,364	1,071,511
South Carolina					9,827
Tennessee				19,074	114,174
Texas					97,666
Utah					5,300
Vermont					(d)
Virginia				12,086	22,686
Washington					16,100
West Virginia		(c)			497,622
Wisconsin					12,386
Other States		422,065	118,000	9,000	f 46,753
Total plain	71,000	3,340,963	1,464,980	1,130,947	15,983,740

DECORATED.

State.	Bone china, delft, and belleek ware.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.
Colorado				$23,639	$23,639
Illinois					72,819
Maryland				1,500	290,500
Massachusetts				86,531	86,531
New Jersey	(g)	(c)		36,400	1,724,749
Ohio				657,829	5,274,957
Pennsylvania				1,238	802,041
West Virginia					750,878
Other States		$21,300		63,200	h 426,198
Total decorated	(g)	21,300		870,337	9,452,312
Grand total	$71,000	3,362,263	$1,464,980	2,001,284	25,436,052
Per cent of total clay products	.05	2.57	1.12	1.53	19.42
Per cent of pottery products	.28	13.22	5.76	7.87	100.00

[a] Including art and chemical pottery, Easter ware faience, Flemish ware, grueby pottery, Herty turpentine cups, porcelain casters, filter tubes, door and shutter knobs, shuttle eyes and thread guides, porcelain hardware trimmings, pins, stilts and spurs for potters' use, tobacco pipes, toy marbles, washboards, and white-lined earthenware.

[b] Sanitary ware for California and Ohio is included in the miscellaneous column of each of these States.

[c] Included in Other States.

[d] Included in f ($46,753).

[e] Porcelain electrical supplies for Missouri included in Missouri miscellaneous.

[f] Made up of State totals of Louisiana, Maine, Montana, New Hampshire, Oregon and Vermont.

[g] Decorated bone china, delft and belleek ware for New Jersey (which is also the total for the United States) is included in New Jersey miscellaneous.

[h] Made up of State totals of Connecticut, Indiana, Louisiana, Minnesota, Missouri, New Hampshire, New York, Oregon, Vermont, and Wisconsin, in order to prevent disclosing the operations of individual establishments.

Value of pottery products by varieties of products in 1902, by States and Territories.

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	(c)		
Missouri	6,401	39,419	(c)		
Montana	(b)				
New Hampshire					
New Jersey	16,309	43,100	(c)	445,820	$468,830
New York	31,873	54,535		(b)	
North Carolina	658	18,854			
Ohio	99,727	1,086,575	$129,591	385,365	2,891,698
Oregon	(b)	(b)			
Pennsylvania	120,323	378,654	(b)		254,856
South Carolina	2,970	13,835			
Tennessee	2,820	48,378			
Texas	3,226	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
Percent 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	49,420
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, washboards, 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.

These tables show that the pottery products of the United States were valued at $25,436,052 in 1903, as compared with $24,127,453 in 1902, a gain of $1,308,599, or 5.42 per cent. In 1902 the gain over 1901 was $1,663,593, or 7.41 per cent, and in 1901 the gain over 1900 was $2,665,290, or 13.46 per cent.

As in previous years, the white ware, principally for domestic use, composed by far the larger part of the pottery produced in this country, though the commoner grades, such as earthenware and stoneware, had a more general geographical distribution.

The following table gives the value of the pottery products and of the plain and decorated ware made in each State for 1902 and 1903 by States and Territories:

Value of pottery products of the United States in 1903, by States and Territories.

State.	Plain.	Decorated.	Total.
Alabama	$23,320		$23,320
Arkansas	11,600		11,600
California	49,478		49,478
Colorado	33,230	$23,639	56,869
Connecticut	77,250	35,200	112,450
District of Columbia	10,854		10,854
Georgia	22,142		22,142
Illinois	826,914	72,819	899,733
Indiana	510,658	70,311	580,969
Iowa	55,762		55,762
Kansas	23,529		23,529
Kentucky	139,827		139,827
Louisiana	(a)	(a)	(a)
Maine	(a)		(a)
Maryland	182,755	290,500	473,255
Massachusetts	214,305	86,531	300,836
Michigan	48,007		48,007
Minnesota	395,713	1,865	397,578
Mississippi	14,296		14,296
Missouri	50,601	800	51,401
Montana	(a)		(a)
New Hampshire	(a)	(a)	(a)
New Jersey	4,590,477	1,724,749	6,315,226
New York	981,636	292,442	1,274,078
North Carolina	14,232		14,232
Ohio	5,813,130	5,274,957	11,088,087
Oregon	(a)	(a)	(a)
Pennsylvania	1,071,511	802,041	1,873,552
South Carolina	9,827		9,827
Tennessee	114,174		114,174
Texas	97,666		97,666
Utah	5,300		5,300
Vermont	(a)	(a)	(a)
Virginia	22,686		22,686
Washington	16,100		16,100
West Virginia	497,622	750,878	1,248,500
Wisconsin	12,386	1,200	13,586
Other States[b]	46,753	24,380	71,133
Total	15,983,740	9,452,312	25,436,052
Per cent of total	62.84	37.16	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 1902, by States and Territories.

State.	Plain.	Decorated.	Total.
Alabama	$26,499		$26,499
Arkansas	9,450		9,450
California	51,607		51,607
Colorado	21,285	$13,030	34,815
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	4,098	53,518
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	8,991		8,991
Washington	13,354		13,354
West Virginia	454,124	712,340	1,166,464
Wisconsin	10,785	1,500	12,285
Other States b	68,044	20,108	88,152
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.

It will be seen from these tables that the plain ware constituted 62.84 per cent of the pottery product in 1903, and the decorated ware 37.16 per cent. These proportions are nearly the same as in 1902 when the percentages were plain, 63.94, and decorated, 36.06, a slight increase being made in 1903 by the decorated ware. As in 1902, nineteen States reported decorated ware, but in only eleven was this product valued at over $10,000. The total value of this variety of ware in 1903 was $9,452,312, as compared with $8,699,439, a gain of $752,873, or 8.65 per cent. The plain ware was valued at $15,983,740 in 1903 as compared with $15,428,014 in 1902, a gain of $555,726, or 3.60 per cent. Ohio is the leading producer of decorated ware, reporting $5,274,957 worth marketed in 1903, which was 55.80 per cent of the total decorated ware reported, and 47.57 per cent of Ohio's total pottery products in 1903. New Jersey and Pennsylvania were the next largest producers of decorated ware, with outputs worth $1,724,749 and $802,041, respectively, followed by West Virginia, whose decorated pottery in 1903 was valued at $750,878 and was 60.14 per cent of her total pottery products. New York and Maryland were close rivals for next place, with decorated pottery valued at $292,442 and $290,500, respectively. The others were comparatively unimportant producers of decorated ware. The first four States mentioned—Ohio, New Jersey, Pennsylvania, and West Virginia—produced decorated ware valued at $8,552,625, or 90.48 per cent of the total. In 1902 these States produced decorated ware valued at $7,857,043, or 90.32 per cent of the total.

The division of the product into plain and decorated is not entirely satisfactory for the reason given heretofore, namely, 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 outputs 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, together with the number of producers reporting each variety and the percentage of each variety in 1902 and 1903:

Value of pottery products in the United States in 1902 and 1903, by varieties.

1903.

Variety.	Plain.	Decorated.	Total.	Number of producers.	Percentage of pottery produced.
Red earthenware	$631,760	$128,315	$760,075	199	2.99
Stoneware	3,185,119	148,023	3,333,142	257	13.10
Yellow and rockingham ware	333,521	....	333,521	17	1.31
C. C. ware	1,027,260	395,336	1,422,596	20	5.59
White granite, semiporcelain, and semivitreous porcelain ware	4,026,365	7,114,551	11,140,916	70	43.80
China	850,152	836,350	1,686,502	11	6.63
Bone china, delft, and belleek ware	71,000	35,000	106,000	4	.42
Sanitary ware	3,495,963	21,300	3,517,263	30	13.83
Porcelain electrical supplies	1,465,580	....	1,465,580	31	5.76
Miscellaneous[a]	897,020	773,437	1,670,457	61	6.57
Total	15,983,740	9,452,312	25,436,052	....	100.00
Per cent of total	62.84	37.16	100.00	....	....

[a] Including art and chemical pottery, Easter ware, faïence, flemish ware; grueby pottery; Herty turpentine cups, porcelain casters; filter tubes; door and shutter knobs; shuttle eyes and thread guides; porcelain hardware trimmings; pins, stilts and spurs for potters' use, tobacco pipes, toy marbles, washboards and white-lined earthenware.

Value of pottery products in the United States in 1902 and 1903, by varieties—Continued.

1902.

Variety.	Plain.	Decorated.	Total.	Number of producers.	Percentage of pottery produced.
Red earthenware	$614,551	$120,835	$735,386	195	3.05
Stoneware	3,066,920	105,315	3,172,235	245	13.15
Yellow and 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	4.96
Total	15,428,014	8,699,439	24,127,453	....	100.00
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 tables are as accurate as can be given for the State totals. From these tables it will be seen that the total value of the pottery products in 1903 was $25,436,052, divided as follows: Plain, $15,983,740, or 62.84 per cent of the total, and decorated, $9,452,312, or $37.16 per cent of the total. In 1902 these totals were $15,428,014, or 63.94 per cent, and $8,699,439, or 36.06 per cent, respectively. The product of greatest value in 1903 was white granite ware, etc., which was valued at $11,140,916, or 43.80 per cent of the total, as compared with $10,555,214 in 1902, or 43.75 per cent, a gain of $585,702, or 5.55 per cent. Of this product, $4,026,365, or 36.14 per cent, was plain ware, and $7,114,551, or 63.86 per cent, was decorated. As in 1902, the ware of next greatest value was sanitary ware, probably all being undecorated, which was valued at $3,517,263, or 13.83 per cent of the total; in 1902 this product was valued at $3,560,662, a decrease of $43,399, or 1.22 per cent. The next product in point of value, as in 1902, was stoneware, which was valued at $3,333,142, or 13.10 per cent of the total; in 1902 this product was valued at $3,172,235, or 13.15 per cent of the total.

The china ware, in which there is always general interest, increased from $1,222,435, produced by 10 potteries in 1902, to $1,686,502, produced by 11 potteries in 1903, an increase of $464,067, or 37.96 per cent. This product in 1903 was nearly evenly divided into plain and decorated, the former being valued at $850,152 and the latter at $836,350, the former being 50.41 per cent and the latter 49.59 per cent of the output.

The white ware, including that made for sanitary purposes (which is of a white body), and porcelain electrical supplies, aggregated $19,338,857, or 76.03 per cent of the whole, as compared with $18,773,705, or 77.81 per cent of the total in 1902. Of the total for white ware for 1903, $10,936,320, or 56.55 per cent, was plain and $8,402,537, or 43.45 per cent, was decorated.

Exclusive of sanitary ware and porcelain electrical supplies, which were practically all plain, the total value of the white-ware products was $14,356,014, of which $5,974,777, or 41.62 per cent, was plain and $8,381,237, or 58.38 per cent, decorated. These figures are also interesting from the fact that they compose the products generally understood by the public, and many manufacturers also, to be "pottery," the products, namely, used for domestic or household purposes, such as tableware, toilet sets, etc.

Yellow and rockingham ware, which for several years seemed to be on the decline, except in 1901, increased its product in 1903, the value being $333,521, as compared with $250,270 in 1902, a gain of $83,251, or 33.26 per cent. Stoneware is made in more States than any pottery product, except red earthenware, and in 1903 the output was valued at $3,333,142, or 13.10 per cent of the total, as compared with $3,172,235 in 1902, or 13.15 per cent of the total. This was a gain of $160,907, or 5.07 per cent.

The number of firms reporting these wares is interesting. They range from 257 reporting stoneware—a gain of 12 over 1902—to 4 firms reporting bone china, delft, and belleek ware. The number of firms reporting china in 1902 was 10; in 1903, 11; 17 firms report yellow and Rockingham ware in each year, 1902 and 1903; those reporting C. C. ware decreased from 23 in 1902 to 20 in 1903; and the firms reporting white granite, etc., increased from 60 in 1902 to 70 in 1903. Thirty-one firms reported sanitary ware in 1902 and 30 in 1903, while 23 reported electrical supplies in 1902 and 31 in 1903. There is no footing to this column for the reason that one would not show the number of operating firms, since many firms report more than one product.

RANK OF STATES.

The following tables show the rank of States in the production of pottery, together with the value of the product in each State, the percentage of the total product made by each State in 1902 and 1903, and the number of firms reporting in each State:

Rank of States, value of output, and percentage to total of pottery products in 1903.

Rank.	State.	Number of firms reporting.	Value.	Per cent. of total product.
1	Ohio	129	$11,088,087	43.59
2	New Jersey	51	6,315,226	24.83
3	Pennsylvania	52	1,873,552	7.37
4	New York	22	1,274,078	5.01
5	West Virginia	8	1,248,500	4.91
6	Illinois	27	899,733	3.54
7	Indiana	16	580,969	2.28
8	Maryland	10	473,255	1.86
9	Minnesota	2	397,578	1.56
10	Massachusetts	17	300,836	1.18
11	Kentucky	11	139,827	.55
12	Tennessee	13	114,174	.45
13	Connecticut	5	112,450	.44
14	Texas	19	97,666	.38
15	Colorado	6	56,869	.22
16	Iowa	7	55,762	.22
17	Missouri	17	51,401	.20
18	California	14	49,478	.20
19	Michigan	4	48,007	.19
20	Kansas	3	23,529	.09
21	Alabama	23	23,320	.09
22	Virginia	3	22,686	.09
23	Georgia	20	22,142	.09
24	Washington	3	16,100	.06
25	Mississippi	8	14,295	.06
26	North Carolina	25	14,232	.06
27	Wisconsin	4	13,586	.05
28	Arkansas	3	11,600	.05
29	District of Columbia	3	10,851	.04
30	South Carolina	8	9,827	.04
31	Utah	4	5,300	.02
	Louisiana, Maine, Montana, New Hampshire, Oregon, and Vermont	9	46,753	.28
	Total	516	a25,436,052	100.00

a Includes $24,380 for decorated pottery, which could not be separately classified without disclosing the operations of individual establishments.

Rank of States, value of output, and percentage to total 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	16,806	.07
23	North Carolina	26	14,512	.06
24	Mississippi	8	14,424	.06
25	Washington	4	13,854	.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

Ohio continues to be the leading pottery producing State, both as to value of the product and the number of firms reporting. In 1903 her pottery products, reported by 129 firms, were valued at $11,088,087, or 43.59 per cent of the total output for the United States; in 1902 her product, reported by 113 firms, was valued at $10,519,138, or 43.60 per cent of the total, practically the same as the percentage of 1903. New Jersey is second in both years, with a product, reported by 51 firms, valued at $6,315,226, or 24.83 per cent of the total in 1903, and at $6,192,959, or 25.67 per cent of the total in 1902. Pennsylvania was again third, with 52 operating firms, a gain of 5, with a product valued at $1,873,552, or 7.37 per cent of the total, as compared with $1,876,265, or 7.78 per cent of the total in 1903, a slight loss. New York and West Virginia exchanged places, the former taking fourth place with a product valued at $1,274,078, or 5.01 per cent of the total, the latter going to fifth with a product valued at $1,248,500, or 4.91 per cent of the total. The next six States, Illinois, Indiana, Maryland, Minnesota, Massachusetts, and Kentucky, maintain the same relative positions in both years. Tennessee jumped from seventeenth place in 1902 to twelfth in 1903, her product more than doubling during the year. Colorado rose from nineteenth place in 1902 to fifteenth in 1903, and Michigan dropped from fourteenth in 1902 to nineteenth in 1903. The other changes in relative rank were unimportant.

The first five States produced ware valued at $21,799,443, or 85.71 per cent of the total; in 1902 the product of these same States was valued at $20,684,257, or 85.73 per cent. The output of the first ten States in 1903 was valued at $24,451,814, or 96.13 per cent of the total; in 1902 the product of these ten States was valued at $23,230,435, or 96.29 per cent of the total.

In the following table will be found a statement of the number of potteries reporting during the years from 1900 to 1903, inclusive, showing the idle and operating plants:

Number of operating and idle potteries in the United States reporting in 1900, 1901, 1902, and 1903.

State.	1900.			1901.			1902.			1903.		
	Operating.	Idle.	Total.	Operating.	Idle.	Total.	Operating.	Idle.	Total.	Operating.	Idle.	Total.
Alabama	27	3	30	22	2	24	24	4	28	23	1	24
Arkansas	7	0	7	5	0	5	8	0	8	8	0	8
California	10	8	18	10	2	12	12	0	12	14	3	17
Colorado	8	0	8	4	1	5	6	1	7	6	1	7
Connecticut	5	0	5	5	0	5	5	0	5	5	0	5
District of Columbia	3	0	3	3	0	3	3	0	3	3	0	3
Florida	1	0	1	1	0	1	1	0	1	0	1	1
Georgia	25	1	26	18	3	21	18	3	21	20	2	22
Idaho	2	0	2	0	1	1	0	1	1	......	......	......
Illinois	29	0	29	24	3	27	25	2	27	27	3	30
Indiana	15	2	17	14	1	15	13	1	14	16	0	16
Iowa	7	0	7	8	3	11	9	1	10	7	1	8
Kansas	3	1	4	1	2	3	2	1	3	3	0	3
Kentucky	10	0	10	11	1	12	11	0	11	11	0	11
Louisiana	3	1	4	3	1	4	2	0	2	3	0	3
Maine	1	1	2	2	0	2	1	1	2	1	0	1
Maryland	8	1	9	10	0	10	12	1	13	10	1	11
Massachusetts	18	1	19	18	0	18	18	0	18	17	0	17
Michigan	4	0	4	5	0	5	4	0	4	4	0	4
Minnesota	3	0	3	2	0	2	2	0	2	2	0	2
Mississippi	7	0	7	6	0	6	8	0	8	8	1	9
Missouri	18	2	20	16	1	17	15	0	15	17	1	18
Montana	1	0	1	1	0	1	1	0	1	1	0	1
Nebraska	0	1	1	0	1	1	0	1	1	0	1	1
New Hampshire	1	0	1	1	0	1	1	0	1	1	0	1
New Jersey	43	2	45	50	2	52	51	3	54	51	0	51
New York	25	2	27	25	1	26	21	4	25	22	2	24
North Carolina	39	4	43	33	4	37	26	3	29	25	2	27
Ohio	113	6	119	109	8	117	113	7	120	129	6	135
Oregon	3	0	3	2	0	2	2	0	2	2	0	2
Pennsylvania	47	3	50	48	3	51	47	5	52	52	2	54
South Carolina	13	1	14	12	0	12	10	2	12	8	2	10
Tennessee	19	1	20	16	1	17	10	1	11	13	2	15
Texas	24	1	25	26	3	29	20	3	23	19	0	19
Utah	4	1	5	2	0	2	3	0	3	4	0	4
Vermont	......	......	......	......	......	......	......	......	......	1	0	1
Virginia	6	3	9	4	3	7	3	3	6	3	3	6
Washington	5	3	8	5	0	5	4	1	5	3	0	3
West Virginia	6	2	8	9	0	9	8	0	8	8	0	8
Wisconsin	3	0	3	4	0	4	4	0	4	4	0	4
Total	561	46	607	535	47	582	518	49	567	546	35	581

The total number of operating firms reporting increased from 518 in 1902 to 546 in 1903, an increase of 28. This increase was chiefly in Ohio and Pennsylvania, these two States showing a total increase of 21. Tennessee and Indiana showed an increase of 3 each; and California, Georgia, Illinois, and Missouri added 2 plants to those reporting in 1902. The following States showed a decrease of 2 plants each from the 1902 figures: Iowa, Maryland, and South Carolina; and the following 1 each: Alabama, Florida, Massachusetts, North Carolina, Texas, and Washington. These decreases, with the exception of Maryland, occurred in unimportant pottery States. The idle plants decreased from 49 in 1902 to 35 in 1903, while the total number of plants reporting increased from 567 in 1902 to 581 in 1903.

TRENTON, N. J., AND EAST LIVERPOOL, OHIO.

The following tables show the pottery products of Trenton, N. J., and East Liverpool, Ohio, the great pottery centers of the country, in 1902 and 1903:

Value of pottery products of Trenton, N. J., and East Liverpool, Ohio, in 1903, by varieties.

Variety.	Trenton.	East Liverpool.	Total.
Yellow and rockingham ware	....	(a)	(a)
C. C. ware	$454,029	$544,564	$998,[illegible]
White granite, semiporcelain and semivitreous porcelain ware	1,570,892	4,104,728	5,675,620
China	805,691	(b)	805,691
Bone china, delft, and belleek ware	106,000	....	106,000
Sanitary ware	2,378,031	....	2,378,031
Porcelain electrical supplies	385,398	366,662	752,060
Miscellaneous[c]	113,391	379,189	492,580
Total	5,813,432	5,395,443	11,208,875
Per cent of total pottery product	22.86	21.21	44.07

[a] In order to prevent disclosing the operations of individual establishments the value of yellow and rockingham ware for East Liverpool is included in East Liverpool miscellaneous.
[b] In order to prevent disclosing the operations of individual establishments the value of china for East Liverpool is included in East Liverpool miscellaneous.
[c] 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 1902, by varieties

Variety.	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.

The remarkable equality in the value of the output of these two pottery centers noted in 1901 and 1902 continues, though the difference in the value of the production in 1903 was considerably greater than in 1902. In 1903 the production was, Trenton, $5,813,432, or 22.86 per cent of the total for the entire country, and East Liverpool, $5,395,443, or 21.21 per cent of the total. This is a difference of $417,989, or 7.75 per cent, in favor of Trenton, the greatest difference between the values of the products of the two cities since comparisons have been made by this office. In 1902 the difference was $101,198, or 1.81 per cent, in favor of Trenton, and in 1901 it was only $13,036. These two cities produced in 1903 pottery valued at $11,208,875, or 44.07 per cent of the total for the entire country; in 1902 their product was valued at $11,293,624, or 46.81 per cent of the country's total. While Trenton increased her production from $5,697,411 in 1902 to $5,813,432 in 1903, a gain of $116,021, or 2.04 per cent, East Liverpool decreased from $5,596,213 in 1902 to $5,395,443 in 1903, a loss of $200,770, or 3.59 per cent. The value of the products of these two cities, which is practically all white ware, was $11,208,875, or 57.96 per cent of the white ware of the entire country; in 1902 these two places made 60.16 per cent of the total white ware. Of the total pottery products of New Jersey, valued at $6,315,226, Trenton produced 92 per cent, while of Ohio's product, valued at $11,088,087, East Liverpool produced only 48.66 per cent. In 1902 these places made 92 per cent and 53.20 per cent of the totals of their respective States. This decrease in the proportion of East Liverpool's production is due to the establishment of potteries elsewhere in the State and in western Pennsylvania and West Virginia, some of them in the immediate vicinity of East Liverpool. As will be seen from these tables, East Liverpool makes no sanitary ware, and Trenton makes no yellow nor rockingham ware. Trenton's leading products are sanitary ware and white granite, and East Liverpool's product is chiefly white granite. Trenton is also the larger producer of china.

IMPORTS AND EXPORTS.

The following table gives the imports of clay products from 1867 to 1903, inclusive. It will be seen that the imports are the heaviest ever reported, increasing from $9,806,271 in 1902 to $11,456,290 in 1903, an increase of $1,650,019, or 16.83 per cent, whereas the production of the United States increased $1,308,599, or 5.42 per cent.

Value of earthenware, china, brick, and tile imported and entered for consumption in the United States, 1867–1903.

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	$418,498	$439,824	$4,280,924	....	$5,187,858
1868	47,208	309,960	403,555	3,244,958	....	4,005,681
1869	84,260	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	962,499	2,664,231	(a)	$666,595	4,343,497
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	68,008	2,022,814	6,556,172	....	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
1903	b 96,890	1,234,223	9,897,588	....	228,589	11,456,290

a Not separately classified after 1883.

b Including rockingham ware.

In the following table will be found a statement of the exports of clay products from the United States from 1895 to 1903, inclusive:

Exports of clay wares of domestic manufacture from the United States, 1895–1903.

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
1903	8,783	63,774	375,503	439,277	527,689	61,312	589,001	1,028,278

It will be noted that the exports of brick continue to decline, though the exports of china showed a slight increase in 1903.

In addition to the foregoing, pottery of foreign manufacture to the value of $19,411 was exported in 1903 and to the value of $18,989 in 1902.

CONSUMPTION.

The imports of pottery into the United States in 1903 were valued at $11,227,701 and the production at $25,436,052, a total of $36,663,753. After deducting the exports, domestic $589,001 and foreign $19,411, there appears a net consumption of $36,055,341, of which the domestic production was 70.55 per cent. The domestic production was 72.91 per cent of consumption in 1902, 71.39 in 1901, 70.75 in 1900, 69.99 in 1899, and 68.49 in 1898. It will thus be seen that the gradual increase of the domestic production as compared with consumption from 1898 to 1902 was checked in 1903 by a fall from 72.91 to 70.55 per cent—in other words, domestic production did not increase as much as importation.

CLAY PRODUCTS IN THE VARIOUS STATES.

The following tables give the statistics of the products of clay, by States, from 1899 to 1903, 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, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	129,512,000	119,906,000	146,522,000	181,040,000	217,715,000
Value	$800,210	$698,583	$943,250	$1,291,941	$1,600,862
Average per M	$6.18	$5.83	$6.44	$7.14	$7.35
Pressed—					
Quantity	3,642,000	1,751,000	3,787,000	6,099,000	8,886,000
Value	$59,918	$32,584	$86,425	$119,302	$229,587
Average per M	$16.45	$18.61	$22.82	$19.56	$25.83
Vitrified—					
Quantity	(a)	....	(a)	....	(a)
Value	(a)	....	(a)	....	(a)
Average per M	$10.00	....	$12.00	....	$15.00
Fancy or ornamental, value	(a)	(a)	$4,540	(a)	(a)
Fire ....value..	$28,798	$48,461	$87,665	$96,491	$200,332
Stove lining........do....	$1,850	$2,100	(a)	$1,250	(b)
Draintile........do....	$9,298	$8,141	$50,156	$10,459	$17,994
Sewer pipe........do....	$479,537	$357,867	$285,599	$381,076	$411,380
Ornamental terra cotta..do....	$76,000	$74,800	$141,380	$173,194	$180,458
Fireproofing........do....	$7,100	$15,500	$12,825	$18,645	$61,649
Tile, not drain........do....	$3,400	(a)	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware........value..	$29,663	$22,387	$28,159	$40,012	$37,740
Yellow and rockingham ware........value..	(a)	....	....	....	....
Sanitary ware........do....	(a)	....	(a)	(a)	(a)
Miscellaneous c........do....	$92,244	$115,575	$129,156	$120,726	$91,541
Total value	$1,587,518	$1,375,998	$1,769,155	$2,253,096	$2,831,543
Number of operating firms reporting	79	72	92	89	105
Rank of State	12	14	11	11	9

a Included in miscellaneous.
b Stove lining included in fire brick in 1903.
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.

CONNECTICUT AND RHODE ISLAND.

Clay products of Connecticut and Rhode Island, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	150,665,000	164,431,000	160,696,000	156,885,000	158,382,000
Value	$751,239	$862,334	$822,079	$896,171	$890,989
Average per M	$4.99	$5.24	$5.12	$5.71	$5.62
Pressed—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$8.78	$15.02	$15.04	$9.09	$15.04
Vitrified—					
Quantity	(a)	(a)	...	(a)	(a)
Value	(a)	(a)	...	(a)	(a)
Average per M	$10.00	$12.00	...	$9.10	$14.08
Fancy or ornamental, value	(a)	(a)	...	(a)	(a)
Fire ... value	(a)	(a)	(a)	(a)	$61,500
Stove lining ... do	(a)	...	(a)	$12,750	(b)
Draintile ... do	...	(a)	...	...	...
Sewer pipe ... do	...	(a)	...	...	...
Fireproofing ... do	(a)	(a)	(a)	(a)	(a)
Tile, not drain ... do	...	(a)	...	...	...
Pottery: [c]					
Earthenware and stoneware ... value	$53,250	$44,250	$48,200	$48,100	$42,250
Miscellaneous [d] ... do	$269,713	$193,388	$260,630	$260,657	$211,330
Total value	$1,074,202	$1,099,972	$1,130,909	$1,217,678	$1,206,069
Number of operating firms reporting	45	47	45	41	41
Rank of Connecticut and Rhode Island	20	20	21	21	23

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Produced by Connecticut alone.
[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.

GEORGIA.

Clay products of Georgia, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	201,991,000	195,463,000	222,111,000	223,705,000	257,844,000
Value	$968,310	$982,083	$1,182,558	$1,114,527	$1,305,896
Average per M	$4.79	$5.02	$5.32	$4.98	$5.06
Pressed—					
Quantity	8,505,000	5,591,000	5,325,000	5,150,000	2,915,000
Value	$78,175	$49,800	$55,700	$46,560	$25,748
Average per M	$9.19	$8.91	$10.46	$9.04	$8.83
Vitrified—					
Quantity	(a)	(a)	(a)	....	(a)
Value	(a)	(a)	(a)	....	(a)
Average per M	$6.25	$10.00	$7.69	....	$10.93
Fancy or ornamental, value	(a)	(a)	$12,200	(a)	$2,100
Fire .... value	$24,400	$35,502	$35,000	(a)	$73,600
Stove lining .... do	(a)	(a)	(a)	....	(b)
Draintile .... do	(a)	(a)	(a)	(a)	(a)
Sewer pipe .... do	$100,612	(a)	$151,500	$174,008	$162,068
Ornamental terra cotta .. do	(a)	$66,000	$71,800	$91,000	$85,500
Fireproofing .... do	(a)	(a)	(a)	$21,650	(a)
Tile, not drain .... do	....	....	(a)	....	....
Pottery:					
Earthenware and stoneware .... value	$28,268	$20,043	$16,410	$16,464	$21,942
Yellow and rockingham ware .... value	....	(a)	(a)	(a)	....
Miscellaneous[c] .... do	$64,230	$39,790	$19,920	$44,460	$54,168
Total value	$1,263,995	$1,193,218	$1,545,083	$1,508,669	$1,731,022
Number of operating firms reporting	109	99	107	108	99
Rank of State	16	17	16	19	16

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[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.

ILLINOIS.

Clay products of Illinois, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	664,684,000	685,161,000	930,561,000	1,023,681,000	1,015,541,000
Value	$3,231,332	$3,981,577	$5,188,654	$5,131,621	$5,388,569
Average per M	$4.86	$5.84	$5.58	$5.01	$5.31
Pressed—					
Quantity	26,941,000	26,040,000	19,241,000	20,943,000	25,122,000
Value	$252,244	$240,989	$204,980	$240,466	$274,723
Average per M	$9.36	$9.25	$10.65	$11.48	$10.93
Vitrified—					
Quantity	88,047,000	87,724,000	99,572,000	91,116,000	96,568,000
Value	$700,524	$720,089	$899,454	$839,784	$1,015,710
Average per M	$7.96	$8.21	$9.03	$9.22	$10.52
Fancy or ornamental, value	$27,868	$15,705	$13,105	$11,893	$12,927
Fire value..	$132,759	$175,259	$212,510	$199,048	$238,106
Draintile do....	$1,026,192	$734,249	$694,588	$693,783	$892,807
Sewer pipe do....	$229,040	$271,085	$348,716	$360,149	$532,858
Ornamental terra cotta..do....	(a)	(a)	$812,015	$1,000,765	$1,198,477
Fireproofing do....	$198,360	$76,347	$263,276	$358,015	$335,838
Tile, not drain do....	$130,085	$229,729	$229,746	$257,049	$283,426
Pottery:					
Earthenware and stoneware value..	$624,927	$641,473	$598,549	$602,708	$694,770
Yellow and rockingham ware value..	(a)	....	(a)	(a)	(a)
C. C. and white granite ware value..	(a)	(a)	....	$56,256	$168,363
Semivitreous porcelain ware value..	(a)	....	(a)	(b)	(b)
Miscellaneous [c] do....	$706,494	$622,407	$176,897	$130,303	$159,208
Total value	$7,259,825	$7,708,859	$9,642,490	$9,881,840	$11,190,797
Number of operating firms reporting	643	569	550	515	502
Rank of State	5	4	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, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	364,675,000	274,383,000	315,966,000	305,233,000	294,890,000
Value	$1,727,697	$1,391,873	$1,624,133	$1,710,385	$1,697,190
Average per M	$4.74	$5.08	$5.14	$5.60	$5.76
Pressed—					
Quantity	14,317,000	19,084,000	27,293,000	24,866,000	24,742,000
Value	$139,978	$172,752	$234,775	$215,202	$232,487
Average per M	$9.78	$9.05	$8.60	$8.65	$9.36
Vitrified—					
Quantity	28,120,000	30,326,000	31,468,000	45,938,000	47,864,000
Value	$258,471	$331,276	$320,221	$441,494	$482,967
Average per M	$9.19	$10.92	$10.18	$9.61	$10.09
Fancy or ornamental, value	$8,841	$7,310	$8,160	$10,398	(a)
Fire ....value	$72,350	$40,976	$51,526	$66,725	$115,526
Stove lining ....do	....	(a)	(a)	....	(e)
Draintile ....do	$839,046	$674,602	$772,241	$807,516	$1,014,706
Sewer pipe ....do	$161,935	$279,719	$253,626	$311,223	$363,212
Ornamental terra cotta ....do	(a)	(a)	(a)	(a)	(a)
Fireproofing ....do	$62,575	$116,581	$91,081	$342,854	(a)
Tile, not drain ....do	$328,041	$343,985	$478,130	$579,896	$463,082
Pottery:					
Earthenware and stoneware ....value	$54,606	$48,544	$54,371	$28,780	$73,160
Yellow and rockingham ware ....value	(a)	....	....	....	....
C. C. and white granite ware ....value	(a)	(a)	(a)	(a)	(a)
Semivitreous porcelain ware ....value	(a)	....	....	(d)	(d)
Sanitary ware ....do	(a)	(a)	(a)	(a)	(a)
Miscellaneous[b] ....do	$581,814	[c] $450,732	$578,190	$769,260	$1,262,295
Total value	$4,235,354	$3,858,350	$4,466,454	$5,283,733	$5,694,695
Number of operating firms reporting	639	567	540	512	490
Rank of State	6	6	7	6	6

[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] Porcelain electrical supplies for Indiana included with New York.
[d] Included in C. C. and white granite ware.
[e] Stove lining included in fire brick in 1903.

IOWA.

Clay products of Iowa, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	220,384,000	222,744,000	249,318,000	228,142,000	191,323,000
Value	$1,328,050	$1,386,641	$1,611,040	$1,575,959	$1,355,129
Average per M	$6.03	$6.23	$6.46	$6.91	$7.08
Pressed—					
Quantity	17,280,000	8,013,000	8,785,000	7,504,000	12,815,000
Value	$160,890	$79,682	$88,164	$80,711	$135,849
Average per M	$9.31	$9.94	$10.04	$10.76	$10.60
Vitrified—					
Quantity	29,555,000	17,338,000	24,270,000	23,905,000	21,888,000
Value	$225,044	$151,386	$241,108	$232,056	$232,510
Average per M	$7.61	$8.73	$9.93	$9.71	$10.62
Fancy or ornamental, value	$4,700	$1,750	$2,229	$1,690	(a)
Fire ... value	(a)	$2,145	$1,810	$850	$975
Stove lining ... do	...	(a)	...	...	(c)
Draintile ... do	$359,568	$377,586	$534,935	$672,212	$1,028,383
Sewer pipe ... do	(a)	$52,462	$54,500	(a)	(a)
Ornamental terra cotta ... do	...	...	...	(a)	...
Fireproofing, terra-cotta lumber, and hollow building block or tile ... value	...	$25,900	$59,270	$108,824	$131,191
Tile, not drain ... do	...	$5,450	$11,903	$2,590	(a)
Pottery:					
Earthenware and stoneware ... value	$30,080	$31,339	$26,200	$43,387	$52,922
Miscellaneous[b] ... do	$125,476	$176,910	$106,666	$130,057	$156,444
Total value	$2,233,808	$2,291,251	$2,737,825	$2,843,336	$3,093,403
Number of operating firms reporting	372	358	341	325	304
Rank of State	8	8	8	8	8

[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 included in fire brick in 1903.

KENTUCKY.

Clay products of Kentucky, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	103,994,000	113,863,000	115,977,000	112,728,000	123,809,000
Value	$546,535	$608,334	$621,756	$659,612	$689,403
Average per M	$5.26	$5.34	$5.36	$5.85	$5.59
Pressed—					
Quantity	2,505,000	2,282,000	2,486,000	6,172,000	6,869,000
Value	$20,275	$21,098	$16,535	$47,027	$53,769
Average per M	$8.09	$9.25	$6.65	$7.62	$7.83
Vitrified—					
Quantity	5,919,000	(a)	(a)	(a)	(a)
Value	$60,398	(a)	(a)	(a)	(a)
Average per M	$10.20	$12.00	$12.71	$13.80	$15.20
Fancy or ornamental, value	(a)	(a)	(a)	....	....
Fire.........value	$334,630	$393,220	$377,741	$605,448	$873,294
Stove lining.........do	....	(a)	(a)	(a)	(b)
Draintile.........do	$36,132	$26,727	$29,498	$26,039	$20,621
Sewer pipe.........do	(a)	(a)	$100,705	(a)	(a)
Ornamental terra cotta..do	....	(a)	....	....	....
Fireproofing.........do	(a)	(a)	(a)	....	(a)
Tile, not drain.........do	(a)	(a)	(a)	$237,469	$222,490
Pottery:					
Earthenware and stoneware.........value	$104,605	$131,497	$139,697	$137,043	$139,827
Miscellaneous [c].........do	$255,853	$300,448	$228,611	$160,405	$191,625
Total value	$1,358,428	$1,481,324	$1,514,543	$1,873,043	$2,190,959
Number of operating firms reporting	111	118	117	111	113
Rank of State	14	12	18	15	11

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[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, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	111,479,000	117,830,000	113,457,000	141,235,000	147,663,000
Value	$682,247	$724,013	$676,708	$879,995	$976,969
Average per M	$6.12	$6.14	$5.96	$6.23	$6.62
Pressed—					
Quantity	14,335,000	4,439,000	5,772,000	3,457,000	2,728,000
Value	$157,918	$60,729	$76,792	$45,375	$40,479
Average per M	$11.02	$13.68	$13.30	$13.13	$14.84
Vitrified—					
Quantity	50,000	74,000	(a)	(a)	(a)
Value	$700	$595	(a)	(a)	(a)
Average per M	$14.00	$8.04	$15.00	$15.51	$9.46
Fancy or ornamental, value	$6,997	$9,886	$11,000	(a)	(a)
Fire value	$325,812	$321,666	$342,055	$277,290	$272,295
Stove lining do	$32,457	$36,049	$40,237	$21,540	(b)
Draintile do	$3,673	$2,363	$2,402	$2,105	$1,355
Sewer pipe do	(a)	(a)	(a)	(a)	....
Ornamental terra cotta do	....	(a)	(a)	(a)	(a)
Tile, not drain do	(a)	(a)	$16,586	(a)	(a)
Pottery:					
Earthenware and stoneware value	$15,225	$8,115	$13,374	$13,651	$16,428
Yellow and rockingham ware value	(a)	(a)	(a)	(a)	(a)
C. C. and white granite ware value	(a)	(a)	$176,637	$505,722	$450,000
Miscellaneous [c] do	$454,612	$548,440	$249,864	$159,684	$151,295
Total value	$1,679,641	$1,711,856	$1,605,655	$1,905,362	$1,908,821
Number of operating firms reporting	66	55	66	68	59
Rank of State	11	11	13	13	15

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[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.

MASSACHUSETTS.

Clay products of Massachusetts, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	230,437,000	198,693,000	170,455,000	241,376,000	190,812,000
Value	$1,256,767	$1,123,586	$1,060,493	$1,529,671	$1,236,103
Average per M	$5.45	$5.65	$6.22	$6.34	$6.48
Pressed—					
Quantity	3,710,000	4,884,000	6,950,000	3,631,000	2,625,000
Value	$79,280	$87,575	$98,892	$69,230	$52,450
Average per M	$21.37	$17.93	$14.23	$19.07	$19.98
Fancy or ornamental, value	(a)	(a)	$63,040	(a)	(a)
Fire value	$22,792	$69,400	$57,945	$54,342	$200,225
Stove lining do	$143,547	$144,044	$135,570	$133,752	(d)
Draintile do	(a)	....	....	....	....
Ornamental terra cotta do	(a)	(a)	(a)	(a)	(a)
Fireproofing do	$70,573	(a)	(a)	(a)	(a)
Tile, not drain do	....	(a)	(a)	$67,418	(a)
Pottery:					
Earthenware and stoneware value	$198,866	$176,902	$204,038	$206,808	$198,382
C. C. and white granite ware value	(a)	(a)	(a)	(a)	(a)
Miscellaneous[b] do	$409,885	[c] $231,594	$250,859	$314,446	$121,525
Total value	$2,181,710	$1,833,101	$1,870,837	$2,375,667	$2,108,685
Number of operating firms reporting	111	101	90	90	86
Rank of State	9	10	10	10	12

[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] Includes pottery products of Maine.
[d] Stove lining included in fire brick in 1903.

MICHIGAN.

Clay products of Michigan, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	200,144,000	180,892,000	215,836,000	237,254,000	215,791,000
Value	$933,176	$863,250	$1,095,254	$1,331,752	$1,251,572
Average per M	$4.66	$4.77	$5.07	$5.61	$5.80
Pressed—					
Quantity	4,290,000	8,421,000	9,476,000	5,684,000	2,225,000
Value	$58,920	$48,411	$64,031	$42,792	$19,000
Average per M	$13.73	$5.75	$6.76	$7.53	$8.54
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$12.00	$12.42	$12.30	$12.26	$13.27
Fancy or ornamental, value	(a)	(a)	(a)	(a)	(a)
Fire ... value	(a)	(a)	.....	.....	(a)
Stove lining ... do	.....	.....	(a)	.....	(c)
Draintile ... do	$140,171	$114,747	$98,972	$96,645	$129,028
Sewer pipe ... do	$50,300	$57,916	(a)	(a)	(a)
Ornamental terra cotta ... do	.....	(a)	.....	.....	(a)
Fireproofing terra cotta, lumber, and hollow building tile or blocks ... value	$5,900	$2,350	$1,880	$3,290	$19,138
Tile, not drain ... do	.....	(a)	.....	(a)	.....
Pottery:					
Earthenware and stoneware ... value	$29,641	$34,317	$42,465	$44,098	$42,007
Miscellaneous[b] ... do	$65,889	$60,704	$239,432	$225,463	$249,676
Total value	$1,283,997	$1,181,695	$1,542,034	$1,744,040	$1,710,421
Number of operating firms reporting	196	189	180	182	178
Rank of State	15	18	17	16	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.
[c] Stove lining included in fire brick in 1903.

MINNESOTA.

Clay products of Minnesota, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	145,333,000	152,497,000	157,727,000	192,674,000	161,911,000
Value	$754,499	$811,457	$852,303	$1,103,515	$962,728
Average per M	$5.19	$5.32	$5.40	$5.72	$6.07
Pressed—					
Quantity	3,955,000	4,520,000	5,506,000	6,280,000	6,922,000
Value	$41,230	$46,830	$55,016	$75,850	$78,990
Average per M	$10.42	$10.36	$9.99	$12.08	$11.40
Vitrified—					
Quantity	....	(a)	....	....	195,000
Value	....	(a)	....	....	$1,875
Average per M	....	$6.00	....	....	$9.62
Fancy or ornamental, value	(a)	(a)	(a)	(a)	(a)
Fire .... value	....	(a)	(a)	(a)	....
Draintile .... do	$11,400	$2,745	$6,739	$2,219	$10,087
Sewer pipe .... do	(a)	(a)	(a)	(a)	(a)
Ornamental terra cotta .. do	....	....	....	(a)	....
Fireproofing .... do	(a)	(a)	$35,700	$41,000	(a)
Tile, not drain .... do	....	(a)	(a)	(a)	....
Pottery:					
Earthenware and stoneware .... value	$206,365	$278,795	$292,095	$370,725	$397,578
Miscellaneous [b] .... do	$205,203	$256,870	$306,794	$308,422	$453,388
Total value	$1,218,697	$1,396,697	$1,548,647	$1,901,731	$1,924,566
Number of operating firms reporting	116	114	116	111	116
Rank of State	18	13	15	15	14

[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.

MISSOURI.

Clay products of Missouri 1899-1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	258,220,000	195,980,000	276,821,000	292,134,000	274,755,000
Value	$1,345,792	$1,057,497	$1,595,031	$1,832,118	$1,725,258
Average per M	$5.31	$5.40	$5.76	$6.27	$6.28
Pressed—					
Quantity	30,062,000	22,013,000	26,301,000	30,744,000	26,153,000
Value	$281,797	$228,070	$298,158	$358,089	$333,965
Average per M	$9.37	$10.36	$11.34	$11.65	$12.77
Vitrified—					
Quantity	22,594,000	28,019,000	25,860,000	22,288,000	31,496,000
Value	$188,787	$252,783	$225,247	$194,250	$307,237
Average per M	$8.36	$9.02	$8.71	$8.72	$9.75
Fancy or ornamental, value	$49,219	$42,096	$62,108	$49,411	$39,756
Fire ... value	$375,023	$510,166	$620,116	$739,385	$925,915
Stove lining ... do	(a)	(a)	$9,520	(a)	(b)
Draintile ... do	$53,575	$57,900	$45,114	$35,887	$45,368
Sewer pipe ... do	$436,624	$624,932	$788,513	$903,279	1,050,794
Ornamental terra cotta .. do	$184,495	$158,051	$223,554	(a)	$371,006
Fireproofing, terra cotta, lumber, and hollow building tile or blocks ... value	$26,257	$19,529	$59,043	$99,690	$98,888
Tile, not drain ... do	(a)	(a)	$60,202	$103,356	$285,091
Pottery:					
Eathernware and stoneware ... value	$70,169	$69,374	$62,647	$48,913	$50,001
Miscellaneous c ... do	$654,878	$716,169	$425,300	$802,086	$478,338
Total value	$3,666,616	$3,736,567	$4,474,553	$5,166,414	$5,661,607
Number of operating firms reporting	289	267	259	235	242
Rank of State	7	7	6	7	7

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[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, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	394,764,000	331,579,000	351,886,000	300,583,000	272,178,000
Value	$1,809,906	$1,449,694	$1,675,746	$1,506,224	$1,500,295
Average per M	$4.58	$4.37	$4.76	$5.01	$5.51
Pressed—					
Quantity	37,825,000	25,229,000	29,239,000	42,926,000	41,075,000
Value	$609,819	$426,692	$473,188	$552,000	$548,558
Average per M	$16.12	$16.91	$16.18	$12.86	$13.35
Vitrified—					
Quantity	(a)	(a)	2,251,000	1,014,000	1,402,000
Value	(a)	(a)	$22,024	$10,437	$22,196
Average per M	$12.80	$12.48	$9.78	$10.29	$15.83
Fancy or ornamental, value	$48,368	$4,112	$11,514	$11,407	$14,970
Fire value	$638,158	$1,072,535	$780,827	$819,580	$949,392
Stove lining do	(a)	(a)	(a)	$8,477	(b)
Drain tile do	(a)	$55,655	$22,612	$33,020	$30,835
Sewer pipe do	$99,000	$154,481	(a)	(a)	(a)
Ornamental terra cotta do	$660,804	$647,884	$920,664	$861,780	$1,364,094
Fireproofing, terra cotta, lumber, and hollow building tile or blocks value	$658,144	$873,706	$610,864	$965,047	$1,326,654
Tile, not drain do	$87,123	$508,392	$486,122	$795,153	$784,150
Pottery:					
Earthenware and stoneware value	$59,500	$75,250	$82,009	$59,820	$65,004
Yellow and rockingham ware value	(a)	(a)	(a)	(a)	(a)
C. C. ware do	$751,444	$544,249	$443,455	$581,267	$454,029
White granite ware do	$442,354	$1,139,620	$1,486,263	$1,431,270	$1,576,892
Semivitreous porcelain ware value	$372,350	$375,926	$225,962		
China do	$494,870	$577,593	$665,948	$680,868	$886,691
Bone china, delft, and belleek ware value	$42,000	$65,800	$270,696	$90,840	$106,000
Sanitary ware do	$1,850,225	$1,843,358	$2,244,904	$2,807,322	$2,794,984
Porcelain electrical supplies value	$154,807	$285,466	$342,479	$358,496	$865,398
Miscellaneous[c] do	$2,078,901	[d] $828,010	[e] $917,151	[f] $1,040,805	[g] $749,894
Total value	$10,787,273	$10,928,423	$11,681,878	$12,613,263	$13,416,909
Number of operating firms reporting	159	149	160	154	159
Rank of State	3	3	3	3	3

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[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.
[g] Also includes enameled brick valued at $218,463.

NEW YORK.

Clay products of New York, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	1,246,756,000	1,009,041,000	1,016,237,000	1,061,712,000	1,068,464,000
Value	$5,275,194	$4,266,715	$4,947,599	$5,021,132	$5,305,522
Average per M	$4.23	$4.23	$4.87	$4.73	$4.96
Pressed—					
Quantity	24,796,000	19,204,000	18,721,000	18,963,000	18,388,000
Value	$324,645	$249,078	$254,696	$249,573	$248,760
Average per M	$13.09	$12.97	$13.60	$13.16	$13.53
Vitrified—					
Quantity	32,350,000	29,943,000	29,950,000	27,009,000	16,797,000
Value	$342,845	$347,671	$343,343	$322,250	$220,296
Average per M	$10.60	$11.61	$11.46	$11.93	$13.11
Fancy or ornamental, value	(a)	(a)	(a)	....	(a)
Fire ......value	$227,814	$360,933	$293,944	$402,006	$629,245
Stove lining ......do	$74,507	$93,188	$115,054	$132,832	(b)
Draintile ......do	$41,921	$89,019	$73,554	$110,301	$140,181
Sewer pipe ......do	$51,298	$94,293	$96,770	$209,105	$134,360
Ornamental terra cotta ..do	$417,350	$676,408	$754,911	(a)	$947,153
Fireproofing ......do	$108,961	$93,994	$98,947	$123,497	(a)
Tile, not drain ......do	$91,645	$105,519	$140,890	$125,680	$150,504
Pottery:					
Earthenware and stoneware ......value	$67,899	$62,215	$76,068	$86,708	$82,810
Yellow and rockingham ware ......value	....	....	....	....	(a)
C. C. and white granite ware ......value	....	(a)	(a)	(a)	(a)
China ......do	$386,680	$371,564	$441,667	(a)	(a)
Sanitary ware ......do	....	(a)	(a)	(a)	(a)
Porcelain electrical supplies ......value	$125,234	$257,832	$310,214	$391,819	$474,842
Miscellaneous [c]	$590,424	[d] $592,177	$344,061	$1,239,710	$875,079
Total value	$8,076,412	$7,660,606	$8,291,718	$8,414,113	$9,208,252
Number of operating firms reporting	276	269	276	262	242
Rank of State	4	5	5	5	5

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[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, 1899-1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	467,888,000	411,582,000	489,275,000	538,552,000	497,071,000
Value	$2,427,684	$2,232,090	$2,725,512	$3,091,847	$3,002,506
Average per M	$5.19	$5.42	$5.57	$5.74	$6.04
Pressed—					
Quantity	48,829,000	40,923,000	69,405,000	63,815,000	50,997,000
Value	$466,555	$433,086	$612,718	$674,822	$633,101
Average per M	$9.55	$10.58	$8.83	$10.57	$12.41
Vitrified—					
Quantity	145,657,000	146,693,000	175,757,000	186,786,000	202,649,000
Value	$1,133,509	$1,118,106	$1,443,537	$1,643,582	$1,860,071
Average per M	$7.78	$7.62	$8.21	$8.80	$9.17
Fancy or ornamental, value	$42,037	[a] $47,155	[a] $60,908	[a] $47,376	$42,522
Fire ......value..	$976,693	$1,340,775	$1,287,059	$1,327,982	$1,561,986
Stove lining ......do....	([b])	([b])	([b])	$192,460	([d])
Draintile ......do....	$977,773	$715,874	$707,409	$894,713	$1,149,990
Sewer pipe ......do....	$1,680,724	$2,243,386	$2,735,703	$2,646,134	$3,295,635
Ornamental terra cotta ..do....	....	$2,857	([b])	$18,289	([b])
Fireproofing, terra cotta lumber, and hollow building tile or blocks ......value..	$346,090	$351,884	$357,284	$757,613	$865,649
Tile, not drain ......do....	$565,094	$690,257	$996,005	$1,156,371	$1,072,108
Pottery:					
Earthenware and stoneware ......value..	$748,170	$949,451	$952,329	$1,311,686	$1,225,735
Yellow and Rockingham ware ......value..	$159,553	$175,176	$206,843	$129,591	$222,904
C. C. ware ......do....	$789,044	$1,056,226	$726,321	$729,526	$762,475
White granite ware..do....	$1,143,990	$2,767,887	$2,710,726	$6,757,661	$6,681,080
Semivitreous porcelain ware ......value..	$2,676,412	$2,251,213	$3,520,008		
China ......do....	$424,428	([b])	([b])	([b])	$265,300
Sanitary ware ......do....	([b])	([b])	([b])	([b])	([b])
Porcelain electrical supplies ......value..	$190,314	$247,135	$325,664	$415,874	$486,740
Miscellaneous [c] ......do....	$1,752,555	$1,682,120	$2,206,959	$2,454,271	[e] $2,080,381
Total value	$16,500,625	$18,304,628	$21,574,985	$24,249,748	$25,208,128
Number of operating firms reporting	960	871	818	801	815
Rank of State	1	1	1	1	1

[a] Including enameled brick.
[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.
[d] Stove lining included in fire brick in 1903.
[e] Includes enameled brick valued at $32,562.

PENNSYLVANIA.

Clay products of Pennsylvania, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	782,944,000	744,663,000	875,631,000	949,718,000	927,212,000
Value	$4,537,305	$4,484,590	$5,357,079	$6,074,352	$6,174,437
Average per M	$5.80	$6.02	$6.12	$6.40	$6.66
Pressed—					
Quantity	88,784,000	54,068,000	70,207,000	77,746,000	80,177,000
Value	$959,000	$596,559	$844,087	$966,530	$1,050,805
Average per M	$10.80	$11.03	$12.02	$12.43	$13.11
Vitrified—					
Quantity	89,017,000	57,827,000	73,498,000	76,024,000	72,039,000
Value	$702,782	$481,670	$670,081	$716,887	$685,274
Average per M	$7.89	$8.33	$9.12	$9.43	$9.51
Fancy or ornamental, value	$57,299	$57,279	$74,726	$20,972	$32,602
Fire value..	$4,921,339	$4,587,991	$4,791,083	$6,080,213	$6,537,076
Stove lining do....	$106,851	$90,348	$86,190	$116,658	(d)
Draintile do....	$26,719	$8,420	$7,409	$9,317	$11,451
Sewer pipe do....	$204,400	$522,650	$438,998	$550,481	$727,465
Ornamental terra cotta..do....	$139,100	$180,100	$314,900	$243,800	$329,004
Fireproofing, terra-cotta lumber, hollow building tile or blocks value..	$110,210	$95,957	$101,652	$138,839	$278,621
Tile, not drain do....	(a)	$191,878	$188,525	$282,431	$207,608
Pottery:					
Earthenware and stoneware value..	$277,156	$344,139	$431,433	$499,227	$533,585
Yellow and rockingham ware value..	(a)	(a)	(a)	(a)	(a)
C. C. ware do....	(a)	(a)	....	(a)	....
White granite ware..do....	$201,057	$830,000	$839,903	$1,099 011	$1,036,194
Sanitary ware do....	(a)	....	(a)	$146,000	$144,414
Miscellaneous [b] do....	$1,860,027	$920,167	$1,175,676	[c] $938,712	$1,096,838
Total value	$14,103,245	$13,391,748	$15,321,742	$17,833,425	$18,847,824
Number of operating firms reporting	550	508	507	511	523
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] Also includes enameled brick valued at $57,183.
[d] Stove lining included in fire brick in 1903.

TEXAS.

Clay products of Texas, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	174,472,000	170,124,000	222,459,000	217,461,000	178,134,000
Value	$947,980	$964,743	$1,396,889	$1,353,489	$1,074,051
Average per M	$5.43	$5.67	$6.28	$6.22	$6.03
Pressed—					
Quantity	7,316,000	3,827,000	10,138,000	6,844,000	5,462,000
Value	$60,061	$35,605	$95,492	$73,619	$65,628
Average per M	$8.21	$9.30	$9.42	$10.76	$12.02
Vitrified—					
Quantity	(a)	(a)	(a)	(a)	(a)
Value	(a)	(a)	(a)	(a)	(a)
Average per M	$9.83	$8.96	$8.70	$9.23	$[illegible].68
Fancy or ornamental, value	$3,147	$1,109	$1,339	$4,557	$11,240
Fire ... value	$23,234	$14,144	$23,337	$17,781	$22,333
Draintile ... do	$2,325	$2,164	$904	$2,766	(a)
Sewer pipe ... do	$58,753	(a)	(a)	(a)	(a)
Fireproofing ... do	(a)	...	...	...	...
Tile, not drain ... do	...	(a)	$2,950	(a)	(a)
Pottery:					
Earthenware and stoneware ... value	$74,052	$87,464	$90,876	$96,402	$96,136
Miscellaneous[b] ... do	$51,567	$65,788	$111,588	$145,200	$208,192
Total value	$1,221,119	$1,171,017	$1,723,375	$1,693,814	$1,472,680
Number of operating firms reporting	125	193	201	172	168
Rank of State	17	19	12	17	20

[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, 1899-1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	128,847,000	153,409,000	171,624,000	192,337,000	189,891,000
Value	$765,598	$934,185	$1,139,894	$1,185,362	$1,245,861
Average per M	$5.94	$6.09	$6.64	$6.16	$6.56
Pressed—					
Quantity	18,712,000	15,617,000	17,650,000	20,433,000	18,866,000
Value	$242,137	$275,847	$267,028	$344,139	$303,431
Average per M	$12.94	$17.66	$15.13	$16.84	$16.08
Vitrified—					
Quantity	5,000,000	3,692,000			(a)
Value	$50,000	$44,067			(a)
Average per M	$10.00	$11.94			$8.92
Fancy or ornamental, value	$16,117	$17,921	$20,429	(a)	$27,330
Fire.....value	(a)	$26,573	$3,971	$13,847	$54,171
Draintile.....do	$5,160	$3,285	$3,978	$4,240	$4,750
Sewer pipe.....do		(a)			
Pottery:					
Earthenware and stoneware.....value	$1,480	$925	(a)	(a)	(a)
Miscellaneous [b].....do	$13,292	$2,392	$4,047	30,245	$37,808
Total value	$1,093,784	$1,305,195	$1,439,347	$1,577,833	$1,673,346
Number of operating firms reporting	96	112	109	98	100
Rank of State	19	15	19	18	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, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	49,908,000	108,760,000	60,004,000	81,166,000	88,060,000
Value	$269,656	$708,861	$348,452	$527,661	$576,404
Average per M	$5.40	$6.83	$5.81	$6.50	$6.55
Pressed—					
Quantity	2,196,000	1,610,000	(a)	(a)	269,000
Value	$16,218	$16,797	(a)	(a)	$3,356
Average per M	$7.39	$10.43	$7.12	$14.33	$12.48
Vitrified—					
Quantity	53,451,000	53,492,000	62,805,000	60,549,000	51,782,000
Value	$415,089	$474,880	$555,389	$578,777	$576,258
Average per M	$7.77	$8.88	$8.84	$9.56	$11.13
Fancy or ornamental, value	(a)	....	(a)	....	....
Fire .... value	$54,400	$149,257	$102,300	$23,633	$70,802
Stove lining	....	(a)	....	....	(b)
Draintile .... value	$3,656	$1,346	$1,485	$1,226	$1,499
Sewer pipe .... do	(a)	(a)	(a)	(a)	(a)
Fireproofing .... do	(a)	....	....	....	....
Tile, not drain .... do	(a)	(a)	(a)	(a)	(a)
Pottery:					
Earthenware and stoneware .... value	$16,464	$9,827	$13,069	$15,018	$16,600
C. C. and white granite ware .... value	(a)	(a)	$419,873	$1,026,446	$1,099,900
Semivitreous porcelain ware .... value	(a)	....	(a)	(c)	
Sanitary ware .... do	(a)	(a)	(a)	(a)	(a)
Miscellaneous[d] .... do	$676,056	$655,797	$505,912	$345,783	$213,741
Total value	$1,451,539	$2,016,765	$1,946,480	$2,518,544	$2,558,560
Number of operating firms reporting	55	53	58	53	56
Rank of State	13	9	9	9	10

[a] Included in miscellaneous.
[b] Stove lining included in fire brick in 1903.
[c] Included in white granite ware.
[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.

WISCONSIN.

Clay products of Wisconsin, 1899–1903.

Product.	1899.	1900.	1901.	1902.	1903.
Brick:					
Common—					
Quantity	178,722,000	156,586,000	187,173,000	152,127,000	181,722,000
Value	$1,078,101	$963,461	$1,151,838	$919,883	$1,198,360
Average per M	$6.00	$6.15	$6.15	$6.05	$6.57
Pressed—					
Quantity	6,881,000	10,832,000	6,527,000	7,724,000	6,794,000
Value	$60,213	$84,601	$54,879	$70,308	$62,857
Average per M	$8.75	$7.81	$8.38	$9.10	$9.25
Vitrified—					
Quantity	(a)		(a)		(a)
Value	(a)		(a)		(a)
Average per M	$15.00		$7.50		$12.00
Fancy or ornamental, value	$1,975	$2,272	$2,105	(a)	(a)
Fire ...value		(a)	(a)	(a)	
Draintile ...do	$23,834	$14,995	$22,727	$17,763	$34,556
Tile, not drain ...do		(a)	(a)	(a)	
Pottery:					
Earthenware and stoneware ...value	$13,145	(b)	$12,400	$12,285	$13,586
Miscellaneous [c] ...do	$639,944	$6,850	$4,095	$6,424	$8,037
Total value	$1,811,712	$1,072,179	$1,247,544	$1,026,658	$1,307,396
Number of operating firms reporting	173	168	170	150	158
Rank of State	10	21	20	22	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.

CLAY.

PRODUCTION.

In the following tables will be found statistics of the production of clay in 1902 and 1903. 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:

Production and value of clay in the United States in 1903, 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								
Arizona[a]			10,005	$87,800	13,496	$36,802	(b)	(b)
California								
Colorado					(c)	(c)		
Delaware			14,065	110,273				
Florida							24,184	$124,328
Georgia								
Illinois								
Indiana								
Kentucky					(c)	(c)		
Missouri	130	$695						
Montana								
New Jersey					22,952	24,872	10,225	41,989
New York								
Ohio								
Pennsylvania	(c)	(c)	23,976	145,056				
South Carolina								
Tennessee					(d)	(d)		
Texas								
Vermont	(c)	(c)	1,679	13,251				
West Virginia								
Wisconsin								
Other States[e]	400	710			29,861	44,353		
Total	530	1,405	49,725	356,380	66,309	106,027	34,409	166,317

State.	Fire clay.				Stoneware clay.			
	Raw.		Prepared.		Raw.		Prepared.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	37,165	$20,355	3,552	$7,520				
Arizona[a]	5,094	7,082	1,711	10,988	2,460	$8,282		
California	29,097	30,199			3,950	4,100		
Colorado	12,910	12,860	(c)	(c)	1,810	1,968		
Delaware	(c)	(c)	(c)	(c)				
Florida								

[a] Including Connecticut, Iowa, Maryland, Massachusetts, Michigan, New Hampshire, North Carolina, North Dakota, Oregon, Utah, Virginia, and ball clay (raw) for Tennessee.
[b] Ball clay (prepared) for Utah included in miscellaneous clay (raw).
[c] Included in Other States.
[d] Ball clay (raw) for Tennessee included with Arizona, etc.
[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.

Production and value of clay in the United States in 1903, by States—Continued.

State.	Fire clay.				Stoneware clay.			
	Raw.		Prepared.		Raw.		Prepared.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Georgia					(a)	(a)		
Illinois	21,403	$24,274	14,836	$13,758	18,024	$14,592		
Indiana	31,614	30,637	(a)	(a)	(a)	(a)		
Kentucky	44,288	36,258	(a)	(a)	(a)	(a)		
Missouri	153,539	158,583	31,789	182,429	5,664	3,830		
Montana	3,567	8,210	(a)	(a)				
New Jersey	340,047	450,789	(a)	(a)	24,403	41,153	(a)	(a)
New York	1,091	2,151			(a)	(a)		
Ohio	80,300	56,219	82,930	70,983	22,960	16,689	(a)	(a)
Pennsylvania	106,204	137,983	32,198	63,979	2,676	888		
South Carolina			(a)	(a)				
Tennessee	2,625	3,566			6,913	7,863		
Texas	(a)	(a)	(a)	(a)	830	1,245		
Vermont	(a)	(a)	(a)	(a)				
West Virginia	(a)	(a)	55,958	42,358			(a)	(a)
Wisconsin								
Other States[b]	74,964	67,846	17,044	35,243	1,286	1,646	9,771	$17,513
Total	943,908	1,047,007	240,018	427,253	90,976	97,246	9,771	17,513

State.	Miscellaneous.[f]				Total.	
	Raw.		Prepared.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	100	$250			40,817	$28,125
Arizona[c]	2,767	4,365			35,533	150,319
California	9,000	15,800			42,047	50,099
Colorado	2,500	1,700			37,317	41,454
Delaware					80,285	171,471
Florida	1,000	2,000			25,184	126,328
Georgia	12,822	57,594	4,602	$24,290	17,874	82,334
Illinois	8,750	13,198	8,025	8,025	71,038	73,842
Indiana	1,776	311			43,345	41,673
Kentucky					57,363	67,010
Missouri					191,122	345,537
Montana	3,600	10,800			7,417	21,510
New Jersey	77,369	91,086	10,662	20,743	493,254	684,625
New York	17,561	18,061			18,958	20,963
Ohio	8,662	5,258			198,102	156,892
Pennsylvania	5,609	6,862			170,963	355,128
South Carolina	36,356	133,903	230	805	36,703	135,408
Tennessee	1,890	2,363			[d]11,428	13,792
Texas					1,909	2,865
Vermont					2,829	16,276
West Virginia					65,439	50,911
Wisconsin	630	980	1,278	11,500	1,908	12,480
Other States[b]					(e)	(e)
Total	190,392	364,531	24,797	65,363	1,650,835	2,649,042

[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.
[c] Including Connecticut, Iowa, Maryland, Massachusetts, Michigan, New Hampshire, North Carolina, North Dakota, Oregon, Utah, Virginia, and ball clay (raw) for Tennessee.
[d] Ball clay (raw) for Tennessee included with Arizona, etc.
[e] The total of Other States is distributed among the States to which it belongs, in order that they be fully represented in the totals.
[f] Including brick clay, clay for wall paper, plaster, and boiler covering, paper clay, slip clay, terra-cotta clay, and wad clay.

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	2,870	$2,726	75,913	67,434
Connecticut[b]	1,974	895			52,958	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	14,585
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.

As heretofore New Jersey is the leading clay-producing State, marketing 493,254 tons in 1903, or 29.88 per cent of the total, valued at $684,625, or 25.84 per cent of the total; in 1902 this State produced 494,800 tons, or 34 per cent of the total, valued at $612,721, or 29.73 per cent of the total. Missouri was second in value of product in 1903, marketing 191,122 tons, or 11.58 per cent of the total, valued at $345,537, or 13.04 per cent, displacing Pennsylvania, which produced 170,963 tons, or 10.36 per cent of the total, valued at $355,128, or 13.41 per cent of the total. In 1902 Missouri's product was 121,401 tons, or 8.34 per cent of the total, valued at $134,862, or 6.54 per cent of the total, while Pennsylvania's product in that year was 161,546 tons, or 11.10 per cent of the total, valued at $288,811, or 14.01 per cent of the total.

The following table shows the production of clay in the United States in 1902 and 1903, by varieties and by condition in which sold:

Production and value of clay in the United States in 1902 and 1903, by varieties.

1902.

	Raw.		Prepared.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Kaolin	58,348	$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	4,482	8,660	91,579	113,842
Miscellaneous[a]	253,347	219,810	9,195	18,372	262,542	238,182
Total	1,208,369	1,319,174	251,988	741,898	1,455,357	2,061,072

1903.

	Raw Quantity	Raw Value	Prepared Quantity	Prepared Value	Total Quantity	Total Value
Kaolin	530	$1,405	49,725	$856,380	50,255	$857,785
Ball	66,309	106,027	34,409	166,317	100,718	272,344
Fire	943,908	1,047,007	240,018	427,253	1,183,926	1,474,260
Stoneware	90,976	97,246	9,771	17,513	100,747	114,759
Miscellaneous	190,892	364,531	24,797	65,363	215,189	429,894
Total	1,292,115	1,616,216	358,720	1,032,826	1,650,835	2,649,042

[a] In miscellaneous raw clay are included 39,157 tons of sand, valued at $35,956.

From this table it will be seen that all the varieties of clay increased in value in 1903 over 1902 except kaolin. The reason for this decrease is the fact that in 1902 and previous years some clays were reported as kaolin which should not have been so classified, and so the loss is more apparent than real. The fire-clay product was the most valuable in both years, being valued at $1,474,260 in 1903, or 55.65 per cent of the total. In 1902 this product was valued at $891,185, or 43.24 per cent of the total.

Of the product of 1,650,835 tons, 1,292,115 tons, or 78.27 per cent, were sold as mined and 358,720 tons, or 21.73 per cent, were washed, ground, or prepared in some manner before shipment. In 1902 these percentages were 82.69 and 17.31, respectively.

IMPORTS.

The following table shows the imports of clay into the United States from 1885 to 1903:

Classified imports of clay, 1885–1903.

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	663,879	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
1903	140,257	898,573	29,188	152,018	2,433	36,211	9,076	110,794	180,954	[a]1,198,418

[a] Includes clay not otherwise provided for, valued at $822, but for which no quantity is reported.

THE SAND-LIME BRICK INDUSTRY.

By S. V. Peppel.

INTRODUCTION.

The sand-lime brick industry has become so important in the United States as to be worthy of special consideration. There are in the country probably as many as 50 plants, with a total capacity of, approximately, 1,000,000 brick per day. Up to the present time and owing to the youth of the industry, no very satisfactory statistics have been collected with reference to the actual number of brick manufactured.

During the last few years many articles have appeared in newspapers and trade journals describing a wonderful industry which was to revolutionize the brick business in this country. It was claimed that brick to answer all purposes could be made from sand with a small addition of lime at a cost far cheaper than that of ordinary brick. Time has not yet proved this statement to be true; nevertheless the sand-lime brick industry seems to be already permanent and to have a very promising future in certain sections of this country, those sections, namely, in which clay of good quality is not readily obtainable, but in which a comparatively pure sand is abundant. There are many such locations in Michigan, Wisconsin, and other northwestern States; and the South and the Southwest also offer many inducements to manufacturers of sand-lime brick.

The experience of plants in operation indicates that sand-lime brick can usually be manufactured at a cost below that of common clay brick; when, however, a sand-lime brick is desired which shall in every way be comparable to the fine clay front brick, the cost of production is naturally increased beyond that of common clay brick. The sand-lime brick have been in use long enough, and there has been sufficient experimental work done, both in this country and in foreign countries, to prove that when properly made they have sufficient strength and sufficient water and weather-resisting qualities to make them a safe building material.

HISTORY OF THE INDUSTRY.

The sand-lime brick of to-day is the natural outcome of the improvements made in the old mortar brick, which has been known for years. This mortar brick was at first never more than a molded mixture of lime and sand mortar which was allowed to harden in the air. Later, carbon dioxide was supplied artificially in large quantities so as to hasten the process of hardening. The next improvement was the introduction of carbon dioxide under pressure. Following this use of carbon dioxide under pressure and in the presence of moisture, mild heat was applied. This last process is still used to some extent. But the most marked advance was the one which applied an entirely new principle to the hardening of sand and lime mixtures, and produced what is known to-day as sand-lime brick, an entirely different body from that of the mortar brick. This was the invention of Doctor Michaelis. Some twenty-five or thirty years ago he patented a process for the hardening of mixtures of lime and sand by steam under pressure, thereby introducing into the sand-lime brick an entirely different bond from that in the mortar brick, which in reality has no bond but only a hardened or solidified filler.

Doctor Michaelis allowed this patent to lapse without commercial development, and in consequence the fundamental principle on which the manufacture of sand-lime brick is based is now public property, and all patents must be on details of manufacture or combinations of such details. The term "mortar brick" should be confined to the brick which is hardened by the solidification of the lime through the formation of carbonates, and should not be confounded with the sand-lime brick, which is a different product and has materially different properties.

The commercial development of the sand-lime brick industry does not date back more than fifteen years in foreign countries, and does not exceed four years in this country. In 1896 there were 5 factories in Germany, and there are probably now as many as 200 in operation in that country, with an actual annual output of between 350,000,000 and 400,000,000 brick. Early in 1901 a plant was built in Michigan City, Ind.

Two years ago there were 5 factories in this country, with a total capacity of about 100,000 per day; a year ago there were about 20 plants in existence, with productive capacity in proportion. At least 6,000,000 brick were actually sold in 1902. Full and accurate data are not obtainable for 1903 as to the actual output, but about 20,000,000 brick have been reported as sold in that year. Most of the factories, owing to the fact that they had just started, were not manufacturing to their full capacity during the year.

The development of the industry has been more rapid in this country than it was in foreign countries, for domestic manufacturers profited by the experience of foreign manufacturers, not only as to processes of manufacture, but also by the knowledge acquired by those manufacturers as to what types of machine were best adapted to produce the ends desired. As a result the machinery used in this country for this purpose is, in almost every case, an improvement over that in use in foreign countries.

Owing to the high price of labor in the United States it is absolutely necessary for the manufacturer to reduce this source of cost as much as possible. This has probably been the main incentive which has brought about the extensive introduction of labor-saving devices into American practice.

In this country, as in foreign countries, a number of processes or systems have been introduced, some patented and some not. They all reach the same end and all involve the same fundamental principle—that is, the formation of a bond which consists of calcium-hydro-silicate or calcium-magnesium silicate, or magnesium silicate. There are different processes and different systems because they reach this end by different routes. The value of each will depend on the economy with which they can be operated, since the intelligent handling of the materials under almost all of the systems developed will yield a good brick, but it must be borne in mind that good sand-lime brick can be made without the use of any patent or any chemicals whatsoever, and that no patent can be obtained on the principle or the process of hardening a mixture of sand and lime with steam under pressure in the ordinary way.

SAND-LIME BRICK DEFINED.

Sand-lime brick or sand brick, or the "Kalksandstein" of the Germans, consists of sand particles which are bound together by a network of calcium silicate, or calcium-magnesium silicate, or calcium-hydrosilicate that has been formed by the action of steam under pressure upon a mixture of sand or granular silicate and lime; this lime may be either a high calcium lime or a magnesian lime which has been hydrated prior to the time when the mixture is molded into the desired form. The formation of this calcium-silicate bond is just as distinct a chemical reaction as fusion, and the result is the production of a mass in many ways similar to that produced in the dry-press brick when it is burned. In this class of brick, vitrification does not penetrate to the core of the constituent parts making up the brick; and the same thing is true in the hardening of the sand-lime brick. Sand and lime hardened by the action of steam under pressure form a bond of calcium silicate, which combines particle with particle by extracting enough silicate from each to satisfy the chemical affinities of the hydrated lime.

PROPERTIES OF SAND-LIME BRICK.

Porosity.—The experimental work done by the writer for the Ohio geological survey shows that the best grades of sand-lime brick were practically saturated with water at the end of 48 hours, and had taken up the greater part of the water which they would absorb in 24 hours. Sand-lime brick having a crushing strength of 5,000 pounds or more per square inch will absorb water equal to from 8 to 10 per cent of the weight of the dry brick. The writer has known brick which were manufactured in the commercial way, and which probably did not receive the pressure most desirable, to take up 14 or 15 per cent. Some manufacturers, however, claim to get absorption down as low as 6 per cent. The writer has not examined any brick which absorbed less than 8 per cent. It is probably fair to assume 10 per cent as the average of absorption for the commercial product.

Crushing strength.—The crushing strength of the commercial product ranges from 2,500 to 5,500 pounds per square inch. The average crushing strength of 12 samples manufactured under the most favorable conditions was 7,745 pounds per square inch.

The following table gives a comparison of strength shown by sandstone used for construction and by sand-lime brick:

Comparison of crushing strength of natural sandstone and of sand-lime brick.

	Natural sandstone.	Sand-lime brick.
Weight per cubic foot .... pounds..	[a]137	136
Absorption .... per cent..	[a]7.3	8
Crushing strength .... pounds..	[b]6,535	[c]7,745
Coefficient of elasticity	[d]165,440	[e]600,000

[a] Average of 16 samples, Bull. Wis. Survey, No. IV, p. 402.
[b] Average of 51 samples, Bull. Wis. Survey, No. IV, pp. 393-394.
[c] Average of 12 samples tested.
[d] Average of 28 samples, Bull. Wis. Survey, No. IV, p. 399.
[e] Calculated from samples tested.

As will be noted, the weight and the absorption are very nearly the same. The crushing strength is in favor of sand-lime brick, as well as the elasticity. While the average strength of a large number of sandstones is less than that of sand-lime brick, there are some sandstones of great strength, as is shown by the record (taken from "Brownstones of Pennsylvania," Appendix 30) of a stone from White Haven, Pa., which had a crushing strength of 29,252 pounds per square inch.

The coefficient or rather modulus of elasticity is an arbitrary figure supposed to represent the theoretical load at which an inch cube would be pressed to zero length if the block were perfectly elastic to that point. This figure is obtained from the amount or rate of compression, or shrinkage in length with increment of load, up to the commercial elastic limit, and the load at the elastic limit.

The commercial elastic limit is that point at which the compression curve increases by 50 per cent or more. An example will make this more clear. Let it be assumed that with a load of 5,000 pounds on a 1-inch cube, the shrinkage in length would be 0.01 inch; that is, 0.002 inch for each 1,000 pounds of load. Now if, when another 1,000 pounds is added to the 5,000 already on, the total additional shrinkage is 0.002 and 0.001 inch, or 0.003 inch, the commercial elastic limit would be 5,000 pounds per square inch. The high modulus of elasticity shown by sand-lime brick means, of course, that they will make a very rigid structure.

This property of sand-lime brick is perhaps made more clear by the statement that a sand-lime brick cube with a load of 1,000 pounds per square inch only shrinks 0.00125 inch in length. Now since only 250 pounds per square inch is allowed to be placed on the best Portland cement mortar by municipalities, the greatest load that we could ask the brick to carry would only cause a compression of one-fourth that given, or 0.00031 inch per inch of height. This means that in any building, bridge, or other structure which is called upon to carry a varying load, there will be little or no deformation due to this load. In other words, very rigid structures may be made from this material.

The highest modulus of elasticity quoted in Bulletin of Wisconsin Survey, No. IV, p. 399, is one from Ablemans and is 400,800. Limestones go sometimes as high as 1,800,000 and some granites above 2,000,000.

Resistance to weather.—The resistance of sand-lime brick to weather is shown by its behavior in buildings which have been erected in severe climates and have shown no signs of disintegration in a number of years. The writer has observed the condition of a house built in Michigan City, Ind., early in the winter of 1901. This house was inspected late that winter, again in 1902, and again late in the winter of 1903, and no signs of weakness or attack due to the action of frost could be detected. There are buildings in northern Germany which have been standing eight or ten years and which show no signs of disintegration. Severe freezing tests have been applied to sand-lime brick by the Ohio geological survey, and no evidence of weakness has resulted. The experience of Prof. Ira Woolson, of Columbia University, in testing commercial samples has confirmed the work of the writer. The freezing tests which were applied were very severe. Blocks were saturated with water, then frozen rapidly by artificial means, then removed from the freezing can and immediately plunged into warm water, and as soon as completely thawed out they were at once introduced into the freezing-can again. This was repeated as many as twenty times. The bricks were then dried, and their crushing strength was compared with that of duplicates which had been manufactured at the same time and had not been frozen or otherwise exposed to the weather. In every case, except when the bricks contained considerable quantities of clay, there was practically no falling off in the crushing strength. From the foregoing it is evident that, if properly manufactured, sand-lime brick is not at all susceptible to the ravages of frost and moisture.

Fire-resisting properties.—Numerous tests have been made to determine the behavior of sand-lime bricks under the action of fire and water. In every case they have come out with a favorable record. The result may be summed up in the following statement: The application of great heat, followed by sudden quenching with water, destroys to some extent the bond on the surface and to a little depth beneath, but leaves the brick safe and intact. There was seldom any cracking or breaking of the brick, and the softening did not seem to penetrate the brick to any great extent. This is perfectly natural, since the brick are largely made of quartz, which is a poor conductor of heat. Thus it is seen that on this score sand-lime brick compares very favorably with almost all classes of building material.

Color.—The natural color of most of the sand-lime brick on the market is a pleasing gray, occasionally with a faint pink or faint yellow tinge, depending on the mineral make-up of the sand. With a comparatively pure quartz, a brick which is almost white is produced; but most of the sands used contain enough impurities to give the brick a gray aspect. There is no difficulty, however, in coloring this brick by the addition of mineral oxide, and in this way a brick of almost any color can be had. A desirable feature in this connection is the readiness with which a color once produced can be obtained again.

COMPOSITION.

The analysis given below is that of a sand-lime brick made in Germany, and probably represents the average composition of the ordinary sand-lime brick. Of course, the composition will depend upon the mineral make-up of the sand and the composition and quantity of the lime used.

Analysis of German sand-lime brick.

	Per cent.
SiO_2 (sand and Sol. SiO_2)	84
$Fe_2O_3+Al_2O_3$	2
CaO	7
MgO, H_2O and CO_2 and alkalies	7
Total	100

When three grams were ground fine and treated with a large amount of water, only a trace of Ca was found in the water.

CONDITIONS ESSENTIAL TO SUCCESS IN MANUFACTURE.

RAW MATERIALS.

The materials necessary to the manufacture of a good sand-lime brick are a comparatively pure sand or granular silicate, with the preference in favor of a quartz sand, and a comparatively pure lime of either type, with the preference in favor of a high calcium lime. A brick which is fairly good at the time of manufacture can be made with almost any sand, if the process of manufacture is adapted to fit the case, but unless the sand is comparatively pure, the weathering properties of the brick will suffer, and the brick will weaken in time.

PREPARATION OF RAW MATERIALS.

This is a very important step in the process of manufacture, and carelessness in this operation is perhaps more responsible than any other one detail for irregularity in the product. If the lime is not evenly distributed, the strength of the brick will not be fully developed; and in cases of imperfect mixing and improper slaking both at the same time, masses of lime may remain sufficient to cause rupture by expansion during the process of hardening, when the lime is completely hydrated by the steam.

The method most desirable for the preparation of the raw materials will depend upon local conditions. For instance, an essentially dry sand may be available, or one that is quite wet; dolomite lime alone may be obtainable, or only a high calcium lime, or only one that has already been hydrated. So far as wet sand is concerned, it may be dried artificially, or it may be dried by the heat generated by the slaking of the quicklime which is added to it.

There is another method possible which the writer does not believe is used anywhere in the United States, at least, and that is that the sand may be used wet and mixed wet with the wet-lime putty. As to the lime, the essential problem is so to handle or treat it that it shall be completely or approximately hydrated prior to the time it enters the hardening cylinder. A great deal of difficulty has been experienced in this direction by many manufacturers. There are a number of lime hydrates on the market which are very satisfactory for making mortar or plaster, but when tried for sand-lime brick they are found to be unsatisfactory, usually producing brick from one-fourth of an inch to 1 inch too long, because of the expansion of these hydrates in the hardening cylinder. It is only fair to state, however, that these hydrates are dolomite lime, which is more difficult to slake than calcium lime. If the lime be slaked with steam, there will be no further expansion when it is introduced into steam again; nor is there any material expansion in the brick when a lime in which hydration is 90 per cent complete is used.

SAND.

Ordinary impurities.—The ordinary impurities in sands are for the most part silicates, represented by clay, mica, feldspar, and almost always some ferric oxide. In the general run of cases, feldspar and mica are not present in any important quantity, but there are regions in which the sands are rich in one or the other, and sometimes in both. Oxide of iron, which is almost always present in greater or less quantity, reacts very slowly, if at all, with silica, in the presence of steam under pressure; it may therefore be considered inert except for its coloring action, unless it acts as a promoter of chemical combination, as is the case with ferric oxide in the manufacture of Portland cement. No attempt has been made to determine whether or not this is the case in the manufacture of sand-lime brick. By far the most widespread impurity in sand is clay, or kaolinite. If there is any impurity in sand, clay is nearly always present, and there are many sands which carry considerable quantities of clay. Its effect on the sand-lime brick process is therefore important.

Professor Rinni,[a] of Hanover, commenting on the examination of a number of sections of sand-lime brick under the microscope, says: "Mica flakes do not seem to have been materially attacked. Quartz and feldspar do not show much if any difference."

Kaolin.—The following table, taken from the Transactions of the American Ceramic Society,[b] shows the effect of the presence of kaolin in the sand:

Effect of kaolin in sand in the manufacture of sand-lime brick.

Number of test.	Composition of mixtures.					When tested.						Per cent water absorption.
	Parts coarse sand.	Parts fine sand (including impurities).	Per cent kaolin.	Per cent quicklime.		At once after hardening.		After aging.		After freezing.		
				Pure CaO.	Dolomitic.	Crushing strength.	Tensile strength.	Crushing strength.	Tensile strength.	Crushing strength.	Tensile strength.	
85	4	1	2.5	......	5	2766	338	2449	194	2917	219	8.32
86	4	1	5.0	......	5	2500	210	2376	277	2481	181	8.00
87	4	1	10.0	......	5	1943	184	1687	157	1910	121	8.50
88	4	1	20.0	......	5	1705	162	1325	138	1477	93	9.00

DATA.—Molding pressure, 10,000 pounds per square inch; steam pressure, 150 pounds per square inch. Temperature in hardening cylinder, 185° C. Time exposed to steam, ten hours.

In connection with this table it will be noted that the per cent of lime used was small and that the conditions of manufacture were not the best, though all conditions were identical. The crushing strength, as well as the tensile strength, decreases with the increase of kaolin. It should be observed also that after freezing both crushing and tensile strength were materially less than they were before freezing; especially is this the case with the tensile strength. Other tests made at the same time indicate that with the use of greater pressure the influence of kaolin is to decrease the crushing strength and to increase the tensile strength, and that there was no material weakness shown by the action of frost when as much as 10 per cent of kaolin or clay was present. It would seem reasonable, therefore, to conclude that kaolin or clay up to 6 or 8 per cent may not be dangerous, and may possibly be advantageous.

Sands with a large percentage of clay in them should not be used, because there will be danger of disintegration from the attack of age and water. The influence of kaolin or clay can to some extent be counteracted by the introduction of a larger percentage of lime.

Feldspar.—Feldspar, up to 10 per cent, does not seem to have any materially injurious effect. The effect of the introduction of feldspar

[a] Thon Industrie Zeitung, 1903, No. 16, p. 158.
[b] Trans. Amer. Ceramic Soc., vol. 5, p. 174.

is to decrease crushing strength and to increase tensile strength, but after freezing there is a decided falling off in tensile strength. It is probable that sands containing as high as 10 per cent of feldspar, and possibly more, are not especially dangerous in the manufacture of sand-lime brick.

From theoretical considerations, the presence of silicates in any large quantity would act as a dilutant or inert material with perhaps a few exceptions. Kaolin (Al_2O_3, 2 SiO_2, 2 H_2O) may be converted into anorthite (CaO, Al_2O_3, 2 SiO_2). But this is not known to be the case. Also anorthite, if present in the sand, might take on four molecules more of SiO_2, and five molecules of H_2O as water of hydration, and form heulanite (5 H_2O, CaO, Al_2O_3, 6 SiO_2); and the acid orthosilicates represented by phenite (H_2O, 2 CaO, Al_2O_3, 3 SiO_2) might take on a molecule of CaO and give up a molecule of H_2O.

It is hardly likely that the normal silicates would become more basic in the presence of large quantities of available silicic acid. It is not likely that the metasilicates, represented by the simplest silicates of calcium and magnesium, enstatite (MgO, SiO_2) and wollastonite (CaO, SiO_2), can do more than promote crystallization of the calcium or magnesium silicates formed by their mere presence in crystal form.

Physical character.—The physical character of the sand is an important factor, as was determined by Prof. M. Glasenapp, of Riga, who published an account of his investigation in the Thon Industrie Zeitung for 1900. He clearly showed the necessity of using very fine sand for rapid and economical production. Doctor Michaelis recommended a mixture of three parts of coarse to two of fine sand as the best. The relative influence of fine and of coarse sand in the strength of sand-lime brick is well shown by the accompanying table, taken from the Transactions of the American Ceramic Society.[a]

Results of proportionate mixture of coarse and fine sand on strength of sand-lime brick.

Number.	Composition.		Crushing strength per square inch.	Tensile strength per square inch.
	Parts coarse.	Parts fine.		
			Pounds.	*Pounds.*
77	8	2	3,114	131
79	4	2	2,955	144
84	3	2	2,461	224

The proportions of the mixture in the bricks tested were: Coarse sand, 20 to 40 mesh, 50 per cent; 40 to 60 mesh, 33⅓ per cent, and the remainder finer; fine sand, 200 mesh, 97 per cent, and the remainder finer. It is evident from the figures in this table that a decrease in the proportion of coarse sand decreases crushing strength, and that it increases tensile strength by increasing the per cent of fine material

[a] Trans. Amer. Ceramic Soc., vol. 5, p. 171.

present, which is only natural, since chemical union will be more rapid under these conditions. Though this is the case with the range of mixtures indicated, it is probable that a limit would be reached in both directions at which these conditions would not be maintained. The reason for the low crushing strength shown in this table is that the bricks were made on a hand press and did not receive sufficient pressure. The best results shown by the work of the Ohio geological survey was with mixtures of two parts coarse and one part fine sand. In selecting sand which is to attain the best results the object should be to get a sand which will contain sufficient very fine particles to combine with the lime, and which when pressed will leave the smallest possible interstitial spaces, thus reducing the quantity of lime necessary for welding these particles together.

Work done in connection with the cement industry has shown that practically none of the sand coarser than 100 mesh, and only a part of that of 150 mesh enters into the active cement reaction.

The finer the material, as a whole, the more difficult will it be so to mix it as to get a coating or film over each particle of sand. On the other hand, the union will be more complete, and the product more pleasing to the eye.

A sharp sand would be more desirable than sand with round corners, since the sharp particles give a greater crushing strength, and for two reasons—one is that the sharp corners are more susceptible to chemical union, and the other is that these particles do not slide so readily upon one another, when subjected to pressure, as the particles which have round corners. A sand with round corners will produce a sand-lime brick of sufficient strength to answer all requirements, especially if some fine material is introduced prior to manufacture, or if some of the sand is crushed or ground during the process of manufacture. A comparatively pure sand is essential for cheap manufacture, as well as for the production of a safe and durable material; nor should the sand be too coarse if the best results are to be obtained. It is probable that to produce the best results the sand should not be coarser than 40 mesh, and not so coarse as that, unless there be some fine material present. If, however, there is a very good gradation of the sizes from the very finest to the coarsest, there may be some very coarse particles in the sand, and still a good solid brick, and one of fair appearance, may be produced. It must be borne in mind also that if all of the sand be extremely fine, it will be much more difficult to handle in the press.

LIME.

Almost any good commercial lime will answer the purpose, so long as it is not badly air-slaked. Economy in manufacture will determine that some limes are more desirable than others, because a unit of one kind of lime will go farther in the production of strength in the brick than a unit of some other kind of lime, and that this is the case is shown in the following table,[a] which compares the two types of lime when used under identical conditions. The results given are the average of twelve tests of each kind of lime.

Results of tests of high calcium and dolomitic lime in the manufacture of sand-lime brick.

Number of test.	Composition of mixtures.				When tested.				
	Parts coarse sand.	Parts fine sand (including impurities).	Per cent quicklime.		At once after hardening.		After freezing.		Per cent water absorption.
			Parts CaO.	Dolomitic.	Crushing strength.	Tensile strength.	Crushing strength.	Tensile strength.	
A.........	2	1	10	....	7,745	437	9,007	371	8.62
B.........	2	1	....	10	5,187	286	5,853	314	9.11

DATA: Molding pressure, 15,000 pounds per square inch. Steam pressure, 150 pounds per square inch. Temperature in hardening cylinder, 185° C. Time exposed to steam, 4 to 14 hours.

It will be noted in this table that a unit of high calcium lime will go materially farther in the production of strength than a unit of dolomite lime. In consequence, if the two limes be purchased at the same price, the high calcium lime would be the cheaper of the two. But, if the lime should be shipped a long distance, or if the conditions be such that it must lie some time before it is used, it is probable that the dolomite lime would be as effective as the high calcium lime, owing to the fact that the high calcium lime air-slakes with much greater rapidity, and that in consequence of this property each day makes it less valuable, on account of the formation of carbonates. It is not clear why a high calcium lime should develop so much greater strength, because experience seems to prove that the magnesium oxide is as active as the calcium oxide in attacking silica, if not more so. The only explanation that seems feasible is that the magnesium silicate formed is a much weaker bond than the calcium silicate. Some preliminary experiments seemed to indicate that the magesium silicate formed in sand-lime brick contains a higher percentage of combined water than the calcium silicate.

The quantity of lime necessary to make a good product will depend on the quality of the lime, the type of lime, and its condition and preparation, as well as upon the physical and mineralogical character of the sand. The general practice to-day is to use from 5 to 10 per cent of lime, no matter what kind of lime it is, the various processes not being so arranged that the percentage of lime is absolutely regular in all brick. Any essentially pure lime properly burned, no matter of which type, will be desirable, because each unit of weight will have the active agent, the oxides of calcium and magnesium. There is another good reason in favor of high calcium lime for this purpose, and that is that it slakes so much more rapidly than the lime made from

[a] Trans. Amer. Ceramic Soc., vol. 5, p. 182.

dolomite. Therefore much less care is needed and less time required in order to have a thoroughly slaked product, which is almost essential to the success of manufacturing.

Lime slaking.—Although there are a large number of slaking processes, they all fall within two distinct classes. One is the time-honored method of slaking to a putty, with a slight excess of water, and then allowing the lime to stand some time to ripen. This yields the best possible product, which may be used either in the putty or after being dried and ground to a flocculent powder. The other method—the one which is most used on account of ease and cheapness of operation—is to slake to a dry powder, and if all conditions are just right a satisfactory product can be had in this way. This dry powder is now produced in two ways. The first is by the addition of sufficient water during the agitation of the lime to hydrate as completely as possible and still to leave a dry powder. This process requires water in excess of that theoretically demanded for completing hydration, because unless the process takes place in an inclosed vessel there will be some loss of water from evaporation. The heat of hydration eliminates the excess of water if it has been properly adjusted. There are a number of patented as well as a number of unpatented devices for accomplishing this end. The other method of dry hydration is to slake by the aid of steam in an inclosed vessel.

Two processes are included under this method. One is to slake entirely with steam, and the other is to complete with steam the reaction in the lime already partly slaked with water. In the latter process some of the devices are so constructed that the steam which is generated in the preliminary stage of hydration is confined and utilized to finish the product.

The general practice in this country seems to be in favor of the use of lime hydrated prior to being mixed with the sand; yet there is no real reason why a rapid-slaking lime of high grade should not be used satisfactorily and economically with wet sand in the production of a good brick. If the sand be not too wet, the heat due to chemical reaction between the calcium oxide and the water in the sand will be sufficient to dry the sand. When this method of operation is followed, the mixing machinery must of course be sufficient and be adjusted to meet the special requirements. The simplest and surest way, and the one least liable to cause variations in the product, will naturally be the process in which the sand is dried, and a thoroughly slaked dry hydrate is mixed with it in the desired proportions before any water is added, because, owing to the sticky nature of hydrated lime when moistened, distribution through the sand particles can be accomplished far better while it is dry. When hydrated lime is added in the moist state it forms small nuclei which are quickly surrounded by sand particles, and the only way in which distribution can then be seeured is by prolonged rubbing.

Mixing.—Even distribution of the lime throughout the entire mass of sand is very essential. The presence of fine sand seems to assist this distribution. Different factories differ materially as to the manner of bringing about this result.

All sorts of mixing machines are in use, almost all of which can be made to do the work. All those of the intermittent type yield a thorough mixture, if the mixture is retained in the machine long enough. The mixers which are continuous in their operation also do the work, provided sufficient machines, or large enough machines, are used to keep the material in vigorous agitation a sufficient time. The amount of moisture introduced should be sufficient to yield a mass which resembles that used in dry press-brick manufacture. If the distribution is complete slightly less moisture is required, and the less the moisture it is necessary to introduce the cheaper the process of manufacture will be. The mixture should be just moist enough to hold together when a handful is taken up and squeezed. Of course the mixture will behave in this way also if an excess of moisture be present, but to the practiced eye the correct condition can within safe limits be readily determined. Some manufacturers transfer the mixture of sand and lime directly from the mixer to the press; others allow it to stand for a short time for the purpose of more thorough distribution of the moisture. There are some points in favor of each method of procedure; but it is probable that future practice will eliminate the soaking or storage bins.

MACHINERY.

The mechanical equipment of a plant consists of—

Power and transmission;
Lime-preparing machinery;
Mixing apparatus;
Presses;
Hardening cylinders;
Conveyors;
Tracks and trucks.

Power and transmission.—The power and transmission machinery does not differ materially from that used in other industries.

Lime-preparing machinery.—The lime-preparing machinery has already been incidentally mentioned. When the quicklime processes are used the only preparing machinery necessary is such as will reduce the lump lime to fine powder. This usually consists of a small crusher and a grinder or pulverizer. This machinery should be so constructed or so located as to confine the dust either to the machine itself or to a small compartment. For plants with sufficient capacity the best arrangement is to have a pulverizer with an air separator.

In plants which hydrate their lime prior to mixing with the sand, the machinery used is some sort of a crusher or breaker which breaks the lime down to small lumps, varying in size from that of a pea to about $\frac{1}{4}$-inch in diameter. This breaker is not always used.

Dry hydrate slaking may be divided into two processes, open slaking and inclosed slaking. Open slaking is accomplished in several ways. In the most simple form of open slaking, floor space or bins, usually constructed of concrete, are used, and sufficient water is added to the lump lime, so that after it has stood a few days and dried off, it is for the most part slaked. The resultant product is then screened, and the fine material used, and the remainder thrown back for reslaking. There is a patent process of the same type in which the lime is wet, and then covered with a coating of previously hydrated lime which serves as a protection from the action of the air and retains a good deal of the heat and steam generated. Open-slaking machinery properly consists of mixing machinery, which is not covered. There are a number of machines now used for this purpose, some of them on the pug-mill order, and others on the wet or dry plan. Some are patented and some are not. The patents mainly apply to details of manipulation and not to the mixing machines themselves. One of the patents in this class slakes finely-ground quicklime by constant agitation with water, another slakes lime or ground lime to a putty, and then dries this product by the addition of more quicklime.

The inclosed slaking machines are of three kinds. One kind agitates the lime in an inclosed vessel with water alone; another type not only uses water but introduces some live or exhaust steam as well; the third kind slakes in an inclosed cylinder with steam alone. The slaking of lime in an inclosed cylinder has been patented; but the patent is at present in the courts, and their decision will decide whether it is public property or not.

Mixing apparatus.—Almost every class of mixing machinery has been tried for this purpose, and those now in use fall pretty closely within the following four types: wet pan, pug mill, ball or tube mill, and an inclosed cylinder with curved paddles or S-shaped mixing arms. Each type of machine has its advocates. The main considerations in the selection of a mixing machine should be economy of power; durability of machine, available space, and efficient mixing capacity.

Presses.—It is safe to say that there is no press now made which fulfills all the requirements of the sand-lime brick industry. Not that there are no American or Europen presses which will make good brick, because there are a number of them manufactured on both continents. If the good points of each could be combined, and a few minor defects could be remedied, a very good press would result. The requirements which a good press must fulfil are the following:

1. The press must be able to deliver regularly a pressure of from 200 to 250 tons per brick, and yet not break down if by accident the pressure becomes somewhat greater.

2. The filling of the mold must be accomplished with great accuracy and uniformity.

3. All working parts must be so arranged that they will be free from contact with loose sand; otherwise they will cut out at an alarming rate.

4. The dies and mold linings must be made of the hardest material obtainable.

Work done by the Ohio geological survey and reported in a bulletin published by that survey on "The lime-sand brick industry" and also in volume 5 of the Transactions of the American Ceramic Society indicates clearly that a pressure of from 200 to 250 tons per brick is essential to the development of the greatest strength in the product when mixtures low in moisture are used. The same work indicates that the press is liable to be subject to much greater pressure than this, because, after the application of the first few tons of pressure, the amount of compression is so slight with the increase of pressure that a very small excess of the material will cause the strain on the press to increase at a very rapid rate. Hence, the dry brick press machines now in use which are not provided with some release are very susceptible to breaking down from overstrain. There are probably more presses in use to-day of this type than of any other. If the belts do not slip there is no release. This sort of press makes a brick of uniform size, but if there be too much sand in the mold there will be a breakdown, or if the belt slips it will leave a brick in the mold at a such a point that it will be necessary to stop work and take part of the sand out of the mold.

The small decrease in the volume of the material with increment of pressure accounts for the necessity of filling the molds each time with the same quantity of material, and with material of approximately the same condition of moisture.

The increase of the pressure delivered increases the abrasion of the molds and shortens their life, as well as increases the tendency of the metal abraded from the molds to stain the brick. It is, therefore, probable that in a commercial way the pressure which has been indicated as being most desirable will not be used, but that a happy medium between scientific desirability and present practice will be adopted. It is desirable that the pressure should be delivered to the brick from both sides or from top and bottom. It is also desirable that the pressure be either repeated or that the release of the pressure be not too sudden. In view of the high pressure demanded and the desirability of a slow release, it appears that a properly constructed hydraulic press should have many advantages over those now in use. So far as known, there is no hydraulic press now in use in a commercial way in this industry. There is in existence, however, such a press of experimental size, and also the plans for one of full size, which will no doubt be put upon the market within the next year.

There are two distinct types of presses in use—the ordinary American dry press-brick machine, and what is generally known as the German type of machine with a rotary table. This rotary table has one very distinct advantage over the American type of machine in that the bricks are presented on the top of the die, so that the off-bearer may pick them up, and thus the bricks are not moved nor slid, as is the case with the dry press-brick machine. The result is that fewer bricks are injured. Because of their tenderness, when the bricks are pushed or slid off the die, they frequently leave a ragged edge or a broken-off corner behind. One disadvantage of the German type of press is that it requires more floor space and more power to operate per thousand bricks produced than the American press. There are a number of these machines of German type being manufactured in this country to-day which are copies of German presses. It is safe to say that there are more presses of the American type now in use than there are of the other. There is room for improvement in both before they meet fully the demand of the sand-lime brick manufacturer.

Hardening cylinders.—These are ordinarily nothing more than enormous steam-tight iron or steel receptacles so constructed that cars loaded with brick can be readily introduced. In appearance they resemble enormous boilers or steel tubes, with one entire head removable. The size of the hardening cylinders varies from 5½ to 7 feet in diameter and from 35 to 67 feet in length. The arrangement for fastening the head should be made strong and safe, since all the accidents which have occurred have been due to some defect at this point.

Conveyors.—From the nature of the material it is apparent that the best conveying machinery will be that which will move the material with as little friction between the conveyor and the sand as possible. Broad continuous belts or heavy chain bucket conveyors are perhaps best adapted for this purpose where dump cars are not desirable. If screws or auger machines are used for conveying, they should be of large diameter and large capacity, and should be geared to move slowly.

Tracks and trucks.—Of the trucks, nothing need be said except that they should be well made, strong, and easy running. No trucks should be used without ball or roller bearings, so that the power used in moving them may be small. The tracks also should be first-class, laid with rails of good weight, and kept in good alignment to avoid jolts or jars on the brick, especially before it is hardened.

COST OF PLANT AND OF PRODUCTION.

The cost of plants will, of course, vary slightly from time to time with the rise and fall of hand and machine work, but will vary markedly with the locality at any time. A well-equipped sand-lime brick plant, with a capacity of from 16,000 to 20,000 brick in ten to twelve hours, will cost, independent of site, from $20,000 to $25,000.

The cost of production also will vary considerably with location. The cost of production in this country, independent of depreciation and interest on investment, varies from $2.50 to $4 per 1,000. The selling price ranges in different localites from $8 to $15 per 1,000.

COMPANIES AND PLANTS.

Companies have been incorporated at the following places, and the majority of them have plants in operation or in process of construction:

Alabama:
- Birmingham.
- Mobile.

Arizona:
- Prescott.

Arkansas:
- Fort Smith.

California:
- Bakersfield.
- Los Angeles.
- Riverside.
- San Francisco.

Colorado:
- Colorado Springs.

Connecticut:
- Canaan.
- New Haven.

Delaware:
- Wilmington.

Florida:
- Pensacola.
- Tampa.

Illinois:
- Kankakee.
- Peoria.
- Wilmington.

Indiana:
- Danville.
- Kokomo.
- Lafayette.
- Michigan City.
- Terre Haute.

Iowa:
- Clinton.

Kansas:
- Fort Smith.
- Topeka.
- Wichita.

Kentucky:
- Winchester.

Maryland:
- Cumberland.

Michigan:
- Calumet.
- Detroit.
- Flint.
- Hancock.
- Holland.
- Jackson.
- Saginaw.
- Sault Ste. Marie.
- Sebewaing.

Mississippi:
- Greenville.
- Grenada.

Montana:
- Billings.

New Jersey:
- Atlantic City.
- Jersey City.

New Mexico:
- Albuquerque.

New York:
- Albany.
- Dunkirk.
- Glens Falls.
- Lancaster.
- Newburg.
- New York City.
- Sanford Corners.
- Sandy Hill.
- Waterford.

North Carolina:
- Ashville.
- Wilmington.

Oklahoma:
- Oklahoma City.

Pennsylvania:
- Altoona.
- Genesee.
- Mount Gretna.
- Pittsburg.
- Scranton.

South Carolina:
- Charleston.

South Dakota:
- Deadwood.
- Sioux Falls.

Tennessee:
- Memphis.

Texas:
- Amarillo.
- San Antonio.

Virginia:
- Bramwell.

Wisconsin:
- Westbend.

Canada:
- Brandon.
- Manitoba.
- Montreal.
- Ottawa.

CEMENT.[a]

INTRODUCTION.

The total production of hydraulic cement in the United States in 1903 was 29,899,140 barrels, valued at $31,931,341, an increase of 4,145,636 barrels in quantity and of $6,564,961 in value as compared with 25,753,504 barrels, valued at $25,366,380, produced in 1902.

Of the total production in 1903, 22,342,973 barrels, having a value of $27,713,319, were Portland cement.

The production of natural-rock cement was 7,030,271 barrels, valued at $3,675,520.

The production of Pozzuolana or slag cement was 525,896 barrels, valued at $542,502.

The increased production of Portland cement in 1903 resulted in a glutted market, which made the artificial product so low in price in the eastern part of this country as to seriously interfere with the production of natural-rock cement. Many of the plants whose output is exclusively the natural cement were for this reason shut down during a large part of the year.

PORTLAND CEMENT.

PRODUCTION.

The production of Portland cement in 1903, 22,342,973 barrels, showed an increase of 5,112,329 barrels over that of 1902. This increase in supply was not entirely justified by the demand, and a quantity of the Portland cement produced during the year was left unsold in the bins when the year closed. Prices fell as a result, only the oldest and best-known brands being able to maintain a rate approximating their usual market value. At the present time the outlook seems to indicate that care is required to avoid over-production.

[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 the Portland cement produced in each State during 1901, 1902, and 1903:

Production of Portland cement in the United States in 1901, 1902, and 1903, by States.

State.	1901.			1902.[a]			1903.[b]		
	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.
		Barrels.			*Barrels.*			*Barrels.*	
Alabama				1			1		
Arkansas	1			1			1		
California	[c] 1	146,848	$513,968	2	294,156	$431,910	3	631,151	$1,019,352
Colorado	[d] 1	585,000	643,500	2	82,044	105,016	1	258,773	436,585
Georgia				1			2		
Illinois	4	528,925	581,818	4	767,781	977,541	5	1,257,500	1,914,500
Indiana	2	218,402	240,242	3	536,706	628,244	3	1,077,137	1,347,797
Kansas	1			1	830,050	1,017,824	1	1,019,682	1,265,310
Michigan	10	1,025,718	1,128,290	10	1,577,006	2,134,396	13	1,955,183	2,674,780
Missouri				1			2	825,257	1,164,834
New Jersey	3	1,612,000	1,450,800	2	2,152,158	2,563,355	3	2,693,381	2,944,604
New York	7	617,228	617,228	10	1,156,807	1,521,553	12	1,602,946	2,031,310
Ohio	[e] 7	689,852	758,837	7	563,113	685,571	8	729,519	998,300
Pennsylvania	13	7,091,500	6,382,350	15	8,770,454	10,130,432	17	9,754,313	11,205,892
South Dakota	1			1			1		
Texas	[f] 2	195,752	215,327	2	165,500	234,950	2		
Utah	1			1			1		
Virginia	1			1	334,869	438,286	1	538,131	690,105
West Virginia							1		
Total	56	12,711,225	12,532,360	65	17,230,644	20,864,078	78	22,342,973	27,713,319

[a] The States combined for 1902 are mentioned in the text of the report for 1902.
[b] The States combined for 1903 are given in the text below.
[c] Includes product of the single plant in Utah.
[d] Includes product of the only Portland-cement plant in Kansas.
[e] Includes product of the only Portland-cement plant in Virginia.
[f] Includes product of the single plant in South Dakota.

In such States as have but a single plant their production is combined with that of another State, in order that the separate figures of any plant shall not be revealed. In the table above the Portland-cement product of the only plant in Alabama which produces that variety of cement is combined with the product of the plants in Georgia, Virginia, and West Virginia. The plants in Missouri and Arkansas have their products combined; those in Kansas and Texas, and those in Utah, South Dakota, and Colorado also show combined products, and in each case the result is given in connection with the State which was the largest contributor to the total product. There is but one new State shown in this table for 1903, which is West Virginia.

The following table shows the growth of the Portland-cement industry in the United States since 1890:

Development of the Portland-cement industry in the United States since 1890.

Section	1890.			1900.			1902.		
	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	8	465,832	5.5	10	1,156,807	6.8
Lehigh and Northampton counties, Pa., and Warren County, N. J.	5	201,000	60.0	15	6,153,629	72.6	17	10,829,922	62.8
Ohio	2	22,000	6.5	6	534,215	6.3	7	563,113	3.3
Michigan	......	....	......	6	664,750	7.8	10	1,577,006	9.1
All other sections	5	47,500	14.1	15	663,594	7.8	21	3,103,796	18.0
Total	16	335,500	100.0	50	8,482,020	100.0	65	17,230,644	100.0

Section.	1903.		
	Number of works.	Quantity.	Per cent.
		Barrels.	
New York	12	1,602,946	7.2
Lehigh and Northampton counties, Pa	13	9,631,541	43.1
New Jersey	3	2,693,381	12.1
Ohio	8	729,519	3.3
Michigan	13	1,955,183	8.7
All other sections	29	5,730,403	25.6
Total	78	22,342,973	100.0

As a producer of Portland cement, Pennsylvania is still in the lead by more than 7,000,000 barrels; New Jersey holds second place, as in the preceding year; Michigan ranks third, although one of her large producers was closed down for a time in order so to change the machinery of the plant as to introduce the dry process of manufacture instead of the wet process heretofore used. In the preceding table for 1903 "All other sections" includes the production of Portland cement in Alabama, Arkansas, California, Colorado, Georgia, Illinois, Indiana, Kansas, Missouri, South Dakota, Texas, Utah, Virginia, and West Virginia. In the statement of production for 1890, 1900, and 1902, shown in this table, Warren County, N. J., was included with Lehigh and Northampton counties, Pa., but in the table for 1903 it has been thought best to state separately the output of the counties in Pennsylvania and the output for New Jersey.

THE PORTLAND-CEMENT INDUSTRY, BY STATES.

There were 19 States which contributed to the entire output of Portland cement manufactured in the United States in 1903, detailed accounts of which are as follows:

Alabama.—The only Portland-cement plant in Alabama is located at

Spocari, near Demopolis, in Marengo County. It was an active producer during the year 1903, being closed down only a short time for necessary repairs. The plant is now undergoing improvements which when finished will double its producing capacity. The other plants in this State are producers of slag cement, and in 1903 they were both under the same management.

Arkansas.—The single cement plant in this State produces Portland cement from the deposits of limestone at White Cliffs. The company began producing early in the year, and made a very creditable showing.

California.—The new plant in California for the production of Portland cement was finished in time to begin work in April, 1903, and has been running steadily since that time. The success of the venture has led this company to consider the possibility of erecting a second plant at Santa Cruz. There are at the present time three cement mills in this State, all of which are producers of Portland cement. The demand for cement in this part of the country is steady, prices are good, and there is not an over supply.

Colorado.—In 1903 the only plant producing cement in Colorado was the Portland Cement Company, which, in 1902, bought out the other active plant in the State. In 1903 only 4 kilns were operated by this company, while the machinery of the plant just purchased was brought to the new factory and installed. There are now 6 rotary kilns in active operation, which will increase the output for another year to nearly double its already large production. In addition to its increased facilities for the production of Portland cement, the company has constructed a 3-kettle gypsum factory for the manufacture of gypsum products, and a hydrated lime factory, both of which will be active in 1904.

Georgia.—There were two plants in this State which produced Portland cement in 1903. One was devoted exclusively to this cement and one made it a small proportion of its output only, giving precedence to its large production of natural cement. The new plant, which is located at Rockmart, Polk County, was not completed until late in the year, and only commenced operations after the middle of November. The other plant ran continuously during 1903.

Illinois.—Four of the 5 plants for the production of Portland cement in Illinois ran continuously throughout the year, with the exception of a few weeks idleness for repairs. The remaining plant was idle nearly all the year on account of the lack of a market. There are 8 cement plants in the State, but 3 of them are devoted exclusively to the production of natural-rock cement. The Illinois Steel Company, which is the largest producer of cement in Illinois, has a new factory at Buffington, Ind., which will be active in 1904. This plant will have sixteen 80-foot by 7-foot kilns installed, which will give it a capacity of 4,500 barrels per day of Universal Portland cement. The plant in Illinois produces slag as well as Portland cement.

Indiana.—The 3 plants which produced all the Portland cement made in this State in 1903 had a combined output of more than a million barrels during that year. The Wabash Portland Cement Company's plant was closed down for about three months, during which time 6 additional rotary kilns were installed. The increase in capacity more than made up for the loss of time, and the output of cement showed an increase over that for the previous year. The other 2 companies operated on full time and produced larger outputs than they had done in 1902. The plant of the Midland Portland Cement Company, at Bedford, was not completed in 1903, though its 10 big rotary kilns were in position. A plant is contemplated at Marengo for the production of Portland cement. One other company producing Portland cement has dissolved and a second one has gone into the hands of a receiver. The production of natural-rock cement is an old industry in this State, but that of Portland cement, which is confined entirely to the northern part of the State, is of very recent date.

Kansas.—The new plant for the production of Portland cement, located near Iola, Kans., was not completed until 1904, and therefore its production will be recorded in a future report. The older plant at Iola had a successful year, was not closed down, and increased its production considerably, besides acquiring new Portland-cement property in Texas. The factory contemplated at Independence for the production of Portland cement was not built in 1903. At Chanute, Neosho County, in the southeastern corner of the State, a Portland-cement plant is to be erected, for which ground will probably be broken in December, 1904. The Chanute Cement and Oil Company, which owns at this place nearly 400 acres of lands containing immense beds of high-grade cement rock and shale, is to build the plant. This company is composed of some of the men who were among the very first to start in the cement industry in Michigan; they are among the most successful of the present producers in that State. The fuel for the mills in Kansas is to be natural gas, found in apparently inexhaustible supply on the 4,000 acres of gas and oil property leased by the company, and lying in close proximity to the land containing their deposits of cement rock. The factory is to be equipped with the most modern machinery, and the buildings will be constructed of iron, steel, and concrete. The cement used will be from the company's plants at Bronson and Union City, Mich. The plant will be located so as to connect with three railroads. The oldest plants in the State are producers of natural-rock cement only.

Massachusetts.—A number of years ago a charter was obtained for the production of Portland cement by a firm in this State, but no factory was ever erected. A report received this year from the company states that the project has been definitely abandoned, and that the charter will be canceled or returned.

Michigan.—For the year 1903 Michigan stands third in the production of Portland cement in the United States, ranking every State except Pennsylvania and New Jersey. The Keystone State leads all others by millions of barrels, while New Jersey takes second place by but little more than half a million barrels. Michigan is only entitled to third place by about 350,000 barrels; the lack of which, however, leaves New York fourth in rank. There were 13 active plants in Michigan during the year, but several of those were in operation only a part of the time, some of the winter months being so cold as to compel a shut down in the factories, though the cement season there is a fairly long one. Two of the large plants were shut down half the year for reconstruction, and two were not started until late in the summer. Another was idle a month while necessary repairs were being made. One company shut down in October and went into the hands of a receiver. The plant at Alpena had a large production, notwithstanding the fact that important changes in the raw-material part of its mills were made. The changes were such as to admit of the dry process of manufacture, which replaces the wet process formerly used, and increases the production nearly 100 per cent, with no appreciable increase in the cost of manufacture. Reports from 16 other companies were received, none of which had active plants in 1903. Seven factories are under construction: two companies are only organized, having purchased no land as yet; two companies consolidated; one changed hands, and four failed altogether. In 1897 Michigan had but one cement factory; in 1900 the number of plants had increased to 6; in 1903 Michigan takes third place as a producer and has 13 active factories, with a prospect of a large increase in this number for 1904. Portland is the only cement manufactured in this State.

Missouri.—The expectations of the company, which started in this State late in 1902, were realized in 1903, and the plant had a large output for the year. The second factory, which began producing in 1903, is a larger one, and had an output slightly in advance of its only competitor in the State. In 1904 there will probably be three factories producing Portland cement in Missouri, as the plant of the Mississippi Valley Portland Cement Company, at Louisiana, in Pike County, will be started in the fall of that year. Only Portland cement is made in the State, and until 1902 no cement of any kind had been produced there.

New Jersey.—Of the 7 companies reporting from New Jersey, but 3 were active producers of Portland cement in 1903. The plant at Alpha is a very large and successful one. For six months 20 rotary kilns were continuously active, and during the rest of the year 4 additional ones were in service. The only shut down during 1903 at these works was for holidays, and the output of cement was very large. The plant at New Village has labored under many difficulties, but succeeded in having a product in 1903. It was idle from March to September reconstructing, after a disastrous fire in the coal plant. Three plants are under construction, but were not ready for operation during the year. The Vulcanite plant has always been a successful producer, and in 1903 it ran ahead of any previous production. The State total for this year is larger than that for the preceding year by several hundred thousand barrels.

New York.—The larger proportion of the plants in the Empire State is devoted to the production of natural-rock cement, but in 1903 there were 10 works making Portland cement exclusively, and 2 that made both natural-rock and Portland. Of these two one had a larger production of natural-rock, and one a larger production of Portland cement. One was closed down for about two months for repairs and alterations. Of the 10 active Portland-cement producing plants, one was closed about a month for repairs, and another was idle nearly three months for the same purpose. Another had an overproduction and closed down for a month. One plant spent part of the year in enlarging its capacity, and one was shut down a short time on account of extreme weather. One plant that had been destroyed by fire was rebuilt in time to operate during about half the year. The output of Portland cement for 1903 in New York, as well as the number of plants producing it, showed an increase over the figures for 1902.

Ohio.—Five plants made all the Portland cement that this State produced in 1903, and of these only 2 report continuous activity throughout the year. One plant was closed for a time because of the necessity for repairs, and following that because of a strike; another had an overproduction and took advantage of this fact to shut down for several months and make repairs; the third plant closed down for part of the year to make some changes; notwithstanding this, and the further fact that 3 usually productive plants were idle during the whole year, the total output of artificial cement was larger than it has ever been before. Two of the Portland-cement plants changed hands, and were improved and remodeled; one company abandoned its project and dissolved; while the new plant at Manchester was in process of construction, but with no expectation that it would be finished before the fall of 1904. There are 2 plants which make only natural-rock cement, and 2 devoted to the production of slag cement, making 13 plants in all in the State.

Pennsylvania.—The condition of manufacture of Portland cement in the very home and center of that industry in 1903 was practically the same as that of the preceding year, except that the product exceeded the output for 1902 by almost a million barrels. There were 9 plants actively engaged in producing Portland cement only; of these, but 3 ran on full time, the others being closed down for a longer or shorter space of time, for various reasons—among which were the necessity for repairs, time needed to increase capacity, strikes, and, in several cases, overproduction. The 6 factories which manufacture both Portland and natural-rock cement were all active, and in nearly every case the production for 1903 showed an increase over that for 1902. About the same conditions existed in regard to the time each factory was in operation as were stated above in connection with the plants producing Portland cement exclusively. There were 2 companies that abandoned their projected factories, and 2 that were idle. There is but one company in the State that reported a production of natural-rock cement only, and one that reported a production of slag cement. There were 7 companies having plants under construction, most of which are expected to be active producers in 1904. The plant at Sandts Eddy, in the eastern part of Pennsylvania, was incorporated under the laws of New Jersey, and has a capital stock of $5,000,000. It is reported that when these works are complete, the plant will have a capacity larger than that of any cement factory in the world, and will be able to produce nearly two million barrels of Portland cement per year. There were 26 companies reporting from this State in 1903.

South Dakota.—The Portland-cement plant located at Yankton is the only cement works in South Dakota. It was an active producer in 1903, and had an output which was in excess of the one for the previous year.

Texas.—There was, in 1903, no production of Portland cement reported from the plant which has formerly been used exclusively for that purpose in this State, owing to the fact that the property changed hands, the Iola Portland Cement and Lime Company, of Kansas, being successors to the old company. There was, however, a production of Portland cement reported from the mills which have for several years made both natural rock and Portland cement, but it was not so large as that of the preceding year.

Utah.—There is but one cement plant in this State, and it produces Portland cement exclusively. During more than half of the year 1903 the mills were shut down, in order that they might be reconstructed and enlarged. The works were started up in August, and a good-sized output was the result. It is expected that the production for 1904 will be largely in advance of the record of this plant, which has always been a successful one.

Virginia.—The Portland-cement factory in Virginia, which was the only producer in the State in 1903, had a very large output during the year, the effect of the improvements made in the factory in 1902 being apparent in the nearly double production for this year. There were two plants which produced natural-rock cement, and there was one plant idle. A new plant for the production of Portland cement is contemplated, but as yet the company has not organized. A company which reported as about to build in 1902, has now abandoned the plan, and though not dissolved, is doing nothing.

Washington.—No production of cement was made in this State in 1903, though there seems to be a probability that a plant will be built in the near future.

West Virginia.—In this State one Portland-cement plant was an active producer in 1903, while another plant was idle, and a third one was engaged in making natural-rock cement only. These 3 are the only cement factories in the State.

RELATION OF DOMESTIC PRODUCTION AND CONSUMPTION TO IMPORTS.

The increase in the production of Portland cement in the United States within the last fourteen 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 hydraulic cement imported and entered for consumption, 1890–1903.

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
1903	6,930,271	22,342,973	29,899,140	2,251,969

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: 1901, 272,689 barrels; 1902, 478,555 barrels; 1903, 525,896 barrels.

The following table shows a comparison of the production of Portland cement in the United States with the entire amount of hydraulic cement imported for consumption in 1891, 1900, 1901, 1902, and 1903. The increase in the percentage of total consumption of the home product continues, 1903 marking the highest point yet reached.

Comparison of domestic production of Portland cement with consumption of all hydraulic cements, 1891–1903.

	1891.	1900.	1901.	1902.	1903.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Production in the United States	454,813	8,482,020	12,711,225	17,230,644	22,342,973
Imports	2,988,313	2,386,683	922,426	1,961,013	2,251,969
Total	3,443,126	10,868,703	13,633,651	19,191,657	24,594,942
Exports (domestic and foreign)	....	139,939	417,625	373,414	285,463
Total consumption	3,443,126	10,728,764	13,216,026	18,818,243	24,309,479
Percentage of domestic production to total consumption in the United States.	13.2	79.1	96.2	91.6	91.9

The production and the annual percentage of increase in the last ten years have been as follows:

Production of Portland cement, with increase each year, 1894–1903.

Year.	Quantity.	Increase.	Percentage of increase.	Year.	Quantity.	Increase.	Percentage of increase.
	Barrels.	*Barrels.*			*Barrels.*	*Barrels.*	
1894	798,757	208,105	35.2	1899	5,652,266	1,959,982	53.1
1895	990,324	191,567	24.0	1900	8,482,020	2,829,754	50.1
1896	1,543,023	552,699	55.8	1901	12,711,225	4,229,205	50.0
1897	2,677,775	1,134,752	73.5	1902	17,230,644	4,519,419	35.6
1898	3,692,284	1,014,509	37.9	1903	22,342,973	5,112,329	29.7

The total consumption of all kinds of cement in the United States in 1903 was 30,987,161 barrels, an increase of 2,359,732 barrels over the total consumption of 1902.

NATURAL-ROCK CEMENT.

PRODUCTION.

The quantity of natural-rock cement manufactured in the United States during 1903 was 7,030,271 barrels, having a value of $3,675,520, a decrease in quantity of 1,014,034 barrels and in value of $401,110, as compared with 8,044,305 barrels, valued at $4,076,630, the production of 1902. Reports for 1903 show that the cause of this decline in quantity of natural-rock cement produced was the overproduction and the consequent lowering in price of Portland cement, particularly in the eastern part of the United States.

The following table shows the quantity and value of the natural-rock cement produced in the United States in 1901, 1902, and 1903:

Production of natural-rock cement in 1901, 1902, and 1903, by States.

State.	1901.			1902.			1903.		
	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.
		Barrels.			*Barrels.*			*Barrels.*	
Georgia	2	50,577	$40,967	2	55,535	$31,444	2	80,620	$44,402
Illinois	2	469,842	187,936	3	607,820	156,855	3	543,132	178,900
Indiana and Kentucky	15	2,150,000	752,500	15	1,727,146	869,163	15	1,533,573	766,786
Kansas	[a]2	175,560	97,002	2	160,000	80,000	2	226,293	169,155
Maryland	4	351,829	175,665	4	409,200	150,680	4	269,957	138,619
Minnesota	[b]2	126,000	63,000	2	150,000	67,500	2	175,000	78,750
Nebraska	1								
New York	[c]18	2,234,131	1,117,066	19	3,577,340	2,135,036	20	2,417,137	1,510,529
North Dakota	1			1			1		
Ohio	[d]1	104,000	62,400	2			2	67,025	46,776
Pennsylvania	7	942,364	376,954	6	796,876	340,669	7	1,339,090	576,269
Texas	1			1			2		
Virginia	1			2	34,000	20,000	2	47,922	25,961
West Virginia	1			1	88,475	62,655	1		
Wisconsin	2	481,020	182,788	2	437,913	162,628	2	330,522	139,373
Total	[e]60	7,084,823	3,056,278	[f]62	8,044,305	4,076,630	[g]65	7,030,271	3,675,520

[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 of the report for 1902.
[g] The States wherein the product of cement was combined with that of some other State for 1903 are given in the text below.

The single cement plant in North Dakota has a production which for 1903 has been combined with that of the only plants producing natural-rock cement in Kansas and Texas. The other States stand in the table exactly as the reported productions are given.

As in other similar tables shown in this report, the total results of combined productions are placed against those States which contributed the greater proportion of cement to make the entire quantity.

New York leads all other States, as usual, in the production of natural-rock cement. As this State is the original home of the cement industry in the United States, that position seems to belong to it by right of discovery.

Second in point of production is the natural-rock cement output from the Louisville district, which is the product of Indiana and Kentucky. Pennsylvania, which stands first as a producer of Portland cement, ranks third in the production of natural-rock cement.

THE NATURAL-ROCK CEMENT INDUSTRY, BY STATES.

Of the 16 States mentioned below as properly belonging to those noted under the heading of natural-rock cement producers, only 14 were contributors to the total quantity of that product manufactured in the United States in 1903. Following are the detailed accounts of State productions:

Florida.—The mills at River Junction remained inactive, and the formation of the company for the improvement and enlargement of the plant is still incomplete. No cement was made in this State in 1903.

Georgia.—Of the two plants in Georgia which had a production of natural-rock cement in 1903, one was devoted exclusively to the manufacture of that product, and the other made both Portland and natural-rock cement. The first plant ran ahead of its production for the previous year, and the other factory ran ahead on its natural-rock production only. Both of the plants kept their mills busy during the entire year.

Illinois.—Three of the 8 cement plants in Illinois manufacture natural-rock cement only. The two larger of these were continuously operative during 1903, and had an increased production over that of 1902. The smaller and newer factory, was shut down for nearly six months of the year, labor strikes interfering seriously with the operation of the mills.

Indiana and Kentucky.—In these 2 States the output of natural-rock cement for 1903 was somewhat smaller than that for 1902. Many of the factories were closed for the greater part of the year, and a number were entirely idle. The low price of Portland cement, an overproduction and lack of demand for natural-rock cement, and some minor labor troubles are given as reasons by the various factories reporting for the slightly decreased output during the year. A new company is reported as having been formed at Louisville, with capital for an extensive plant, to be located there.

Kansas.—This State has at present 2 plants which produce natural-rock cement, both of which are located near Fort Scott. Of these, 1 factory was shut down a month because of overproduction, and the other was in operation throughout the year. Their combined production was largely in advance of that for the year 1902.

Maryland.—One of the factories which has for years been among the steady producers of natural-rock cement in the State of Maryland was burned in the early part of 1903, and up to the end of that year had not been made ready for use. One factory was idle, as it has been for several years, and the natural-rock production was, therefore, from the 3 remaining factories which manufacture that product. Of these plants 1 was closed nearly two months for repairs, 1 was shut down after November because the low price of Portland cement rendered competition unprofitable, and 1 was idle nearly one-half of the year on account of labor troubles. The State produces both natural-rock and slag cement.[a]

Minnesota.—The only cement produced in this State is natural-rock cement, and there were but 2 plants manufacturing there in 1903. Of these, 1 ran ahead of its production for the year before and was active continuously, except for the months during which it was too cold to operate the mill. The other factory had a production which equaled that of the previous year, and was idle for repairs only a month. In this section of the country the demand for good cement is constant.

New Mexico.—The new plant producing cement at Ancho, in this State, in 1903 proved to be one for the manufacture of a kind of cement made from gypsum, which product is not reported by this Bureau.

New York.—There were 20 plants for the manufacture of natural-rock cement in the State of New York in 1903, two of which also produced Portland cement. Of the 18 remaining factories, 3 were idle during the year and 15 were used for the production of natural-rock cement only. A company which formerly manufactured natural-rock cement at Lefever Falls has closed down the works there and will for the present burn cement at their Rosendale factory only. One company reporting a product considerably larger than its output for 1902 was closed for a time to repair damage caused by a fire. The plant at Warners, which was burned in 1902, was active again in 1903, and had a good production of cement. One plant was sold during the year, but continued to run except through the coldest weather. Several of the plants that had a production report having been idle a number of months on account of the insufficient demand, and 2 companies report their factories as having been shut down a few months because of labor troubles. Strikes among the building trades, as well as those among the workmen at the factories, were in part

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[a] On p. 795 of Mineral Resources U. S. for 1902 the statement occurs that no attempt to manufacture Portland cement had been made in the State of Maryland, notwithstanding the presence in that State of much material suitable for such an industry. It would have been more strictly in accordance with the facts to state that no record of such an attempt appears in this office, and that no report of such a production was made to the Bureau. The superintendent of the Cumberland Hydraulic Cement and Manufacturing Company has informed the office, since the issue of the annual report for 1902, that his company did manufacture a true Portland cement at Cumberland, Md., as far back as 1896; that they erected a dome kiln of 150-barrel capacity, ground the necessary cement from their limestone and cement quarry, and manufactured a kiln full of Portland cement, which is at the present time under test both in briquettes and laboratory, and also in one pavement. It is further intimated that the manufacture of Portland cement may be begun by this company in the near future.—L. L. KIMBALL.

accountable for the lack of demand and supply in the cement business in 1903.[a]

North Dakota.—The output of the only cement plant in North Dakota is a high-grade natural-rock cement exclusively, and for 1903 it showed an increase over the production of 1902. The factory was idle during about three months in the winter because of difficulty in transportation and to make some improvements in the plant.

Ohio.—The new plant which was projected in this State for the manufacture of natural-rock cement in 1902 did not develop, and there seems to be no immediate prospect that it will do so. The plant at Defiance, which was idle in 1902, remained idle in 1903, its owner being averse to operating the mill on account of his advanced age. The plant near Lisbon, which manufactures only natural-rock cement, was active part of the year, being closed down about six weeks in all for various reasons, among which was the flooding of their mine. The production was about the same as that of the preceding year. Ohio has 1 cement factory devoted to the manufacture of slag cement.

Pennsylvania.—In 1903 the production of natural-rock cement in Pennsylvania ran ahead of its production for the year before, as did the output of Portland cement. There was 1 plant which manufactured only natural-rock cement, and 6 which made both natural-rock and Portland cement. There was also 1 plant which made only slag cement. Of the 6 factories which had a production of both natural-rock and Portland cement, 2 ran on full time, 2 were closed a short time for repairs and improvements, and 2 were idle about a month on account of accumulated stock. One new factory is reported, but the nature of the cement to be manufactured is not stated.

Texas.—The only active cement mill in Texas in 1903 was the one producing both natural-rock and Portland cement. The production of the former variety ran considerably ahead of that for the preceding year, while the output of the latter variety was not equal to that of the year before by some thousands of barrels. This plant was closed down during part of the year on account of the lack of demand for cement and on account of labor strikes. There are 2 other plants in this State, 1 of which manufactures Portland cement and the other produces only natural-rock cement. Both were idle in 1903.

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[a] On p. 800 of Mineral Resources U. S. for 1902 the building of the Buffalo cement plant in 1874 is mentioned. Since the issue of that volume, Mr. Bennett, the president of the Buffalo Cement Company, has informed this Bureau of the fact that the production of the plant mentioned was only a continuation of the manufacture of cement from that particular ledge of rock, which had been worked many years. Mr. Bennett says: "In the fall of 1824 a cement works was constructed at Williamsville, Erie County, N. Y., which is now standing. It was owned and operated by Timothy Hopkins and John S. King, and was afterwards known as the Williamsville Cement Works. This cement was used in the construction of the locks of the Erie Canal at Lockport, and was hauled to that place by wagon. It was afterwards used in the first United States Government stone breakwater in Buffalo, in 1828. On this same ledge, 6 miles nearer Buffalo, the Buffalo Cement Works was afterwards constructed, so that cement has been manufactured continuously on this ledge for the last eighty years."—L. L. KIMBALL.

The former plant has been purchased by the Iola Portland Cement Company, of Kansas, and is being improved and reorganized. It will probably have a production in 1904.

Virginia.—The record of this State for 1903 is an almost exact repetition of its record for 1902, so far as the cement industry is concerned. There were 4 plants in the State, 2 of which produced only natural-rock cement, and their joint production ran ahead of that for the previous year by many thousands of barrels. One of them was idle in order to make improvements, and the other shut down a short time for lack of a market. The third plant is a Portland-cement plant, and the fourth was idle throughout the year. A new company, reporting in 1902, does not return a report for 1903.

West Virginia.—The only plant which produced natural-rock cement in West Virginia was running less than 5 months in 1903, owing to the fact that improvements were being made in the factory. As stated in the report of 1902, the plant which was active at Shepherdstown for many years as a producer of natural-rock cement, has been idle since the death of the proprietor. Negotiations for its purchase by some Baltimore capitalists are pending.

Wisconsin.—This State had an output of natural-rock cement only, there being no Portland or slag cement produced. In 1903 the two cement plants in operation had a production which fell short of the one for the preceding year.

POZZUOLANA OR SLAG CEMENT.

PRODUCTION.

In giving the production of slag cement for 1903 it is not possible to itemize the State productions without disclosing individual figures. The following table shows the total production of slag cement in the United States and the number of plants in each State:

Production of slag cement in the United States in 1903, by States.

State.	1903.		
	Number of works.	Quantity.	Value.
		Barrels.	
Alabama	2		
Illinois	1		
Maryland	1		
New Jersey	1		
Ohio	1		
Pennsylvania	1		
Total	7	525,896	$542,502

THE POZZUOLANA OR SLAG-CEMENT INDUSTRY, BY STATES.

The account in detail of the 6 States contributing to the total quantity of slag cement manufactured in the United States in 1903 is as follows:

Alabama.—This State is the only one which had in 1903 more than one slag-cement plant. Both the plants engaged in this industry last year were operated under the same management, the Southern Cement Company having leased the plant of the Birmingham Cement Company. The mills were busy almost continuously, being shut down only a few weeks for repairs.

Illinois.—The plant in this State which produced Pozzuolana or slag cement is located at North Chicago, and ran on full time the entire year. A plant owned by the same company but used for making Portland cement is located in South Chicago. The output of slag cement for 1903 was considerably in excess of that for 1902.

Maryland.—For the year 1903 the plant manufacturing slag cement at Sparrows Point was idle only a short time while making necessary repairs; except for this, the works were active all the year. Their output of cement was not quite as large as that for the preceding year.

New Jersey.—The production of slag cement in this State is carried on at Perth Amboy. The works were idle a few weeks on account of labor troubles, and the production of slag cement for 1903 was not quite equal to that of 1902. This plant has a number of rotary kilns.

Ohio.—There was but 1 plant actively engaged in making slag cement in Ohio in 1903; but in 1904 the new plant which has been in process of construction will probably be in condition to run. The output of the plant at Youngstown was not nearly as large as that for the previous year, and the cement works were idle about half the year.

Pennsylvania.—The new plant at Sharon had its initial run in 1903 and produced a fair output of slag cement. The works were not operated throughout the entire year, however, and the production for 1904 will probably be larger. This is the first time that Pennsylvania appears in the list of producers of slag cement.

TOTAL PRODUCTION OF HYDRAULIC CEMENTS IN THE UNITED STATES.

The manufacture of natural-rock cement in the United States greatly antedates that of Portland cement, the former beginning about 1818, in New York State, and the latter about 1870, in Pennsylvania. Although the phenomenal growth of the Portland-cement industry within the last few years has made a large increase in the total output of that product, yet by far the greater total stands against the production of natural-rock cement, as shown by the following table:

Total production of natural-rock, Portland, and slag cement in the United States, 1818–1903.

[Barrels.]

Year.	Natural.	Portland.	Pozzuolana or slag.
1818 to 1830	300,000		
1830 to 1840	1,000,000		
1840 to 1850	4,250,000		
1850 to 1860	11,000,000		
1860 to 1870	16,420,000		
1870 to 1880	22,000,000	82,000	
1880	2,030,000	42,000	
1881	2,440,000	60,000	
1882	3,165,000	85,000	
1883	4,190,000	90,000	
1884	4,000,000	100,000	
1885	4,100,000	150,000	
1886	4,186,152	150,000	
1887	6,692,744	250,000	
1888	6,253,295	250,000	
1889	6,531,876	300,000	
1890	7,082,204	335,000	
1891	7,451,535	454,813	
1892	8,211,181	547,440	
1893	7,411,815	590,652	
1894	7,563,488	798,757	
1895	7,741,077	990,324	
1896	7,970,450	1,543,023	12,265
1897	8,311,688	2,677,775	48,329
1898	8,418,924	3,692,284	150,895
1899	9,868,179	5,652,266	335,000
1900	8,383,519	8,482,020	446,609
1901	7,084,823	12,711,225	272,689
1902	8,044,305	17,230,644	478,555
1903	7,030,271	22,342,973	525,896
Total	209,132,526	79,608,196	2,270,238

The figures for natural-rock and Portland cement in this table through the year 1896 are taken from a statement made by Mr. Uriah Cummings, president of the Cummings Cement Company, of Akron, N. Y., in his volume entitled American Cements, 1898, on page 288. The remainder of the table is compiled from the reports in this Office on the production of cement.

IMPORTS.

The table showing the imports of cement into the United States in 1903, by countries, is as follows:

Imports of hydraulic cement into the United States in 1899, 1900, 1901, 1902, and 1903, by countries.

Country.	1899.	1900.	1901	1902.	1903.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
United Kingdom	199,633	267,921	37,390	79,087	146,994
Belgium	624,149	826,289	303,180	615,793	737,576
France	15,649	32,710	11,771	14,922	14,865
Germany	1,193,822	1,155,550	555,038	1,259,265	1,377,414
Other European countries	68,348	75,827	19,077	17,956	27,415
British North America	4,398	4,517	6,066	8,611	4,421
Other countries	2,889	23,869	6,808	4,153	9,265
Total	2,108,888	2,386,688	939,330	1,994,787	2,317,950

The figures used in compiling this table are those which show the total imports, and the figures used elsewhere in this report as imports are those which show the imports withdrawn from the warehouse for consumption in the United States. In 1903 England stands third in the list of foreign countries which sent cement to America. From 1871 to 1876 nearly all importations of foreign cement were from England. In the four years following Germany gradually assumed an important place as rival, and in 1882, while England sent one-half the cement exported to the United States, Germany sent three-fourths of the remainder. Ten years later Germany was the leading foreign country sending cement to America, and since then has held that position.

PRODUCTION OF CEMENT IN CANADA.

The total production of cement in Canada in 1903, according to the preliminary statement of the geological survey of Canada, was 719,993 barrels, valued at $1,166,497. Of this amount 92,252 barrels were natural-rock cement, worth $75,655, and 627,741 barrels were Portland cement, worth $1,090,842.

These figures show an increase in the production of Portland cement in 1903 over that in 1902 of 33,147 barrels, and a decrease in the amount of natural-rock cement produced in 1903, as compared with that produced in 1902, of 32,148 barrels. In 1902 the increase in the production of Portland cement amounted to over 100 per cent and the decrease in the production of natural-rock cement to about 6.5 per cent, as compared with the production for 1901.

PORTLAND CEMENT IN GERMANY.

The condition of the cement industry in Germany is of deep interest to this country, in view of the fact that more than half of the imports of cement into the United States are from that country.

The following extract is from a report made by Mr. F. H. Mason, consul-general at Berlin:[a]

The cement manufacture may be designated as that one of the great long-established industries in this country in which the capacity of production is most excessive and disproportionate to the normal consumptive power of the people. There were in operation in this country at the close of 1899, 261 cement factories, and their number has increased rather than diminished since that time.

During the year 1901 there was consumed in Germany 14,600,000 barrels of cement, while the reports of the several syndicates show that the collective productive capacity of all their factories for the same period was 29,000,000 barrels per annum. The power of production had thus, in respect to Portland cement, outgrown the actual home demand by 100 per cent. Just how much cement was really produced in that year is difficult to ascertain. The cement factories of Germany are divided into several syndicates, which fight each other with persistent valor and reveal as little of the inside workings of their several organizations as possible; but from all indications and estimates there must have been in 1901 a surplus of from 10,000,000 to 12,000,000 barrels, of which there was exported 506,652 tons, leaving a large excess, which broke down the market, reduced profits to a pittance, and brought on a crisis in the industry from which it has not yet recovered.

In tracing the causes which led up to this result, it is noticeable that during the 10 years from 1890 to 1900 all kinds of construction which use cement were phenomenally active in Germany, and the consumption was enormous and steadily increasing. Millions of barrels were used in the construction of the Kaiser Wilhelm and the Ems canals and in improvements in the Rhine, Weser, and other rivers. It was expected that the Midland Canal would also be authorized, and the cement factories made preparations to meet that additional demand, so that the failure and postponement of the project were among the contributing causes to the overproduction of that period. The situation led to a new effort to unite the several local syndicates and groups into which the cement makers were divided into one national and all-embracing combination, which could restrict the output, shut down superfluous factories, and, by getting the industry thoroughly in hand, restore prices to a profitable basis. All such efforts proved futile, and the war between the competing factories was bitter and unrelenting.

The year 1902 brought no substantial relief. The supply of cement everywhere exceeded the demand. Building operations slackened under the general industrial and financial depression, while labor and fuel—two of the principal factors in cement production—maintained practically undiminished values since the prosperous years preceding 1900. The only outlet for the surplus was through exports, and these slowly increased from 497,780 metric tons[b] in 1898 to 528,676 tons in 1889, 543,991 tons in 1900, and 641,520 tons in 1902. Of this large export the United States takes a larger share than any other nation, the shipments to our country aggregating 197,174 tons in 1900, 108,596 tons in 1901, and 246,726 tons in 1902. Next in order of importance in this respect comes the Netherlands, which last year took 66,837 tons of German cement; British South Africa, 36,720 tons; Great Britain, 33,534 tons, and Brazil, 18,209 tons.

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[a] Advance Sheets Cons. Repts., No. 1691, July 8, 1903.
[b] 1 metric ton=2,204⅗ pounds.

Under the present tariff cement is free of duty when imported into Germany, and there was a small influx of 51,947 tons in 1902, which came across the border at points in Belgium, Denmark, France, Austria, and Switzerland, where factories near the frontier were geographically tributary to German territory. To shut out this slight competition the new German tariff imposes a duty of 50 pfennigs (about 12 cents) per 100 kilograms ($1.20 per metric ton) on cement, as against $4.04 per ton duty assessed by Russia, $2.38 in Austria and Switzerland, $1.42 in Sweden, and $1.76 in the United States.

The sum of all recent information is that only the oldest and largest factories in Germany, which enjoy every advantage of location for obtaining raw material and handling their product, are able under present conditions to earn any substantial profit. Many of the newer and smaller establishments are working at a loss. Early in the present year there was a meeting in Berlin of cement manufacturers from all parts of the Empire, which, after a long secret session, appointed a commission to consider and report in April upon a plan for the organization of the entire industry under a cartel or syndicate, which should control output and manage the market. Thus far it would appear that the commission has not reported, and its continued silence is construed as an indication that the differences between local syndicates and individual factories have again been found irreconcilable, and that no general basis of combination can be reached.

In connection with the subject of the manufacture of Portland cement in Germany, it may be of interest to note that the Association of German Portland Cement Manufacturers has adopted the following definition of Portland cement:

An hydraulic cementing material having a specific gravity of not less than 3.10 in the calcined condition, and containing not less than 1.7 parts by weight of lime to one part each of silica, alumina, and ferric oxide, the material being prepared by intimately grinding the raw ingredients, calcining them to not less than clinkering temperature, and then reducing this clinker to a proper fineness.

METHODS OF SHIPPING CEMENT.

The transportation of cements was formerly made in barrels, that being considered the best means that could be used. At present, however, the large proportion of all cement made in this country is shipped in cotton or paper bags. To such an extent is this true that the immense stave industry which was built up in former years at Cherryfield, Me., has been abandoned and the mills shut down, there being an insufficient demand to make the business profitable. In a pamphlet entitled "The Inspection and Testing of Cements," by Mr. R. L. Humphrey, the author says:[a]

Cement is usually shipped in cotton sacks or paper bags, although about 25 per cent of the shipments are in wood. Where cement is going to be used immediately and will not be held long in storage, the bag shipments are undoubtedly more convenient and satisfactory, besides being more easily handled on the work. Such ship-

[a] Humphrey, R. L., The inspection and testing of cements: Jour. Franklin Inst., vol. 1, 1901, pp. 450–451.

ments can also be sampled much more thoroughly. Cement was shipped in barrels in this country in the early days, as it was generally accepted that cement must be kept in tight packages, as it deteriorated in the air; and, besides, nearly all the early natural-cement mills were located along canals, and the cement had to be placed in wooden packages for water shipments. Again, prior to 1893 foreign Portland cement was used very extensively in this country, and on account of the ocean voyage it was absolutely necessary to pack the cement in tight, well-coopered barrels in order to avoid damage to the cement from sea-water, and to the barrel from the handling it received in loading and unloading. When the American cements began to replace the foreign Portland cements the American engineers had become so accustomed to cement in barrels that they continued to insist on shipments of cement being delivered in wood. This sentiment is, however, undergoing a change, and bag shipments are becoming the rule. Another advantage of having cement delivered in sacks is the reduced cost of the package.

The danger of inferior cement being rebagged is readily avoided by requiring the cement manufacturer to seal his bags with a lead seal, such as is the custom in France and other foreign countries. The packages should state plainly the brand, name, and place of manufacture, and all shipments of cement which are not properly labeled should not be inspected.

ACKNOWLEDGMENTS.

It is desired to acknowledge here the almost unfailing courtesy which has been extended to this Bureau by the gentlemen engaged in the manufacture of cement in the United States in 1903. In nearly every instance where information additional to that already given was requested it was forwarded without delay. As these statistics are compiled from data sent by the different manufacturers of cement only, and as no estimates or statements outside of those from the factories themselves are included in the figures showing either production or values, the importance of prompt responses to requests can be readily appreciated. The ability to forward the issue of such a pamphlet as this hinges very largely upon the facility with which returns can be received from cement manufacturers.

PORTLAND CEMENT IN MICHIGAN, 1903.

By L. L. Kimball.

Marl has been known and utilized as a fertilizer and for producing lime in Michigan for many years, and it was used as the principal ingredient in manufacturing Portland cement just across the State line at South Bend, Ind., by Mr. Millen in 1877; and yet it is only within the last seven years that it has been successfully used in producing Portland cement in Michigan. There was a factory started at Kalamazoo in

1872 for the manufacture of Portland cement from the marl beds located near that city, but the old set or dry kiln process proved to be so expensive that this site was ultimately abandoned. At Bronson, where marl was discovered by a section foreman while piles were being sunk for a railroad bridge, and at Union City the first successful marl plants were started, and cement was first produced in 1897. Following these plants were those at Coldwater and Quincy in 1898. The next active mill was at Wyandotte, where, however, the cement is manufactured from limestone brought from Alpena. This mill began producing in 1899. In 1900 the factory at Mosherville first had an output of cement made from marl. At the close of 1903 the total of five marl-using factories which reported in 1900 had increased to thirteen companies reporting production for that year in Michigan, of which ten were using marl as a principal ingredient for their cement and three were using limestone. In addition, the number of plants projected amounted to as many more in all stages of development, ranging from a company which has been organized simply for the purpose of holding certain cement properties and with no immediate intention of building a plant to companies naming the specific dates on which their factories are to begin the manufacture of Portland cement. This astonishing growth of the cement industry, which was the immediate result of the discovery of an abundance of marl in the State and which in 1903 put Michigan third in rank among the States manufacturing Portland cement, received a slight check from the fall in prices paid for cement in 1903 and the early part of 1904. This fall in price made greater economy in manufacture necessary. The further fact that experience began to prove that the difference in quality of the marl deposits was an important consideration and one which could not be safely ignored also tended to render caution in production necessary.

MATERIALS.

In no other State are the calcareous marls so generally used for the manufacture of Portland cement as in Michigan. Cement is manufactured from marl by four companies in New York, by three companies in Ohio, and by two companies in Indiana, but in Michigan it is produced from marl to the exclusion of other materials except at Alpena, Elk Rapids, and Wyandotte, where limestone is used. At the cement plant in Alpena it was at first intended to use the marl deposits on land containing the clay belonging to this company; but the quality as well as the inexhaustible quantity of their limestone deposit altered the original intention, and the plant was erected with machinery adapted to the production of cement from limestone rather than marl, though the wet process of manufacture was used. As stated in another part of this report, the factory has recently been remodeled, so that the dry process could be used instead of the wet.

The numerous deposits of marl in Michigan differ greatly in both quality and quantity, and actual experience in using these deposits sometimes develops difficulties which do no appear in preliminary examinations. In one place where a successful plant has been operating for some years a marl is used for producing cement which has a coarse grain, is loosely constructed, and is of a dirty, grayish color; but it is comparatively free from stones and organic matter; the water drops out of it readily; it is easily separated from its organic matter, and it is not very sticky to handle. This last consideration means much in the economy of a cement factory. This is shown by the experience of another plant located somewhat farther north, in which the machinery is practically a duplicate of that used in the one just mentioned. Although the marl is conveniently located with reference to manufacturing and handling, the output is not nearly so large as that at the other plant, because the marl, fine and white in appearance, works into a compact, sticky mass that requires more fuel for moving, more wetting, and consequently more drying, and is far more expensive and troublesome in every way to handle than the coarse gray marl of the deposit first mentioned. Considerations of this kind make the possession of a large bed of marl a thing of much more doubtful value than was at first supposed. Where the marl is found to contain an excess of organic matter the process of eliminating it and the water it carries becomes one of great expense. Furthermore, the thickness of the deposit must be taken into account. A bed only 8 or 10 feet in depth will be much less economical to handle than one of three times that depth, because in each case the surface growth will be mixed with the marl and will have to be burned to an ash in the kilns, involving an additional cost for fuel. Then there will be a small percentage of marl at the bottom of the deposit which can not be profitably dredged on account of its admixture with the sand or gravel on which it rests. Hence the thicker the deposit of marl between the surface and the bottom layers the greater the supply of available material to be had at the least expense.

These and other considerations in the manufacture of Portland cement in Michigan have raised a question as to whether rock or marl may be used to greater advantage in this State, and the erection of several of the contemplated factories is at the present time being held in abeyance until their stockholders shall have reached a decision in the matter. One company having large holdings of marl land near Frankfort decided to use rock instead of marl, and has bought over 400 acres on which are enormous deposits of limestone, cement rock, shale, and clay. The limestone and cement-rock deposits are near

Charlevoix, in the northern part of the southern peninsula of Michigan, and border on Lake Michigan. The following are analyses of these raw materials:

Analyses of limestone and cement rock from Charlevoix, Mich.

Constituent.	Limestone.		Cement rock.	
	1.	2.	1.	2.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Silica	1.54	1.93	5.74	6.11
Oxide of iron and alumina	1.60	1.21	2.40	2.73
Carbonate of lime	95.64	96.03	87.86	87.42
Carbonate of magnesia	None.	None.	None.	None.
Sulphuric acid	.53	.40	.72	.69
Organic matter	.47	.36	2.98	2.73
Moisture by difference	.22	.07	.30	.32
Total	100.00	100.00	100.00	100.00

The conditions at Charlevoix are favorable for the manufacture of Portland cement, and the materials to be used yield a better quality of cement than could be made for the same expenditure of capital at Frankfort. Two other companies in the State are contemplating a change in their plants to enable them to substitute rock for marl.

PROCESSES.

Although the cement mills in Michigan all turn out practically the same product, and although that product bears almost an unvaryingly good reputation, yet the methods employed in arriving at this result differ in detail at nearly every plant in the State. The various managers find it expedient to alter their processes to meet individual needs and conditions.

At one plant the marl is dropped from the dredge into large buckets standing on a car and is conveyed by cable into the factory just as it comes from the lake, the first process inside the buildings being to put it through the hopper of a separator, where stones, roots, sticks, and other materials likely to break the blades of the mixers and agitators through which the material goes later are taken out. At another plant the dredge is placed on a float, to which is fastened a scow equipped with machinery necessary to remove the undesirable matter immediately, so that the marl is dumped from the dredge directly into the separator. It flows out from this machine in thin streams through pipes and is discharged into scows lying next to the machine. Thence it is towed across the lake to the mill by a steam tug, and here it is drawn up by compressed air through large pipes into the storage tanks inside the buildings. At still another plant the marl deposit adjacent to the mill is not used at present, but, instead, marl is brought by railroad from a lake about 30 miles distant from the factory, experience having proven that the quality of the distant marl is so greatly superior to that of the near-by bed as to quantity of organic matter contained, as to quality of cement produced, and as to the ease with which it can be handled that the cost of moving it is much more than covered by the increased output resulting therefrom. At another plant the marl is brought to the mill by compressed air through tubes, and is not dealt with by hand from the time it is dredged until it is turned out into the storage bins as a finished product.

All the cement plants now operating in Michigan burn their cement in rotary kilns. There is, however, a new plant near Chelsea which is practically completed and will probably be in operation before this report is printed, which is equipped with vertical or dome kilns only. The reason for this is that the manager at this plant believes that a more uniformly even and perfect burning can be accomplished by drying the marl in bricks and packing it between layers of coke for burning than by putting it through a process where inequalities in the size of the clinker affect the degree of perfection to which it can be burned. There is also at this plant an economical and very interesting arrangement of pipes for the utilizing of most of the heat that is usually waste heat. Economy has been observed in many ways, and the results at this mill will be of general interest. The deposit of marl covers over 700 acres of ground, much of which was a marsh and part of which was a shallow lake. This lake is now reduced by drainage to a mere pond, and it is intended ultimately to drain it completely, so that the marl will be practically dry when it is brought to the mill. The property now owned by this company was originally held by the West German Portland Cement Company, and was sold to the present owners because of the failure of that company to develop as was expected.

The problem of thoroughly utilizing the waste heat in the cement factories for the purpose of drying marl is one which engages the attention of most of the managers in Michigan, especially during the prevalence of present prices, and if the problem can be more successfully solved than has yet been done a great step will be taken toward a more economical production of cement in the State. For, although it is entirely possible to dry the marl before it is burned, and although if dried it takes less fuel to burn than is required when it is wet, the drying has usually proved to be so expensive a process as to be unprofitable. Where the wet process is employed a kiln will burn 125 barrels of cement per day, as against 200 barrels burned in the same time where the marl is dried; but the cost of fuel for drying is usually more than double the profit gained on the 75 additional barrels. A plant which is at the present time shut down has machinery for drying the marl which is about as extensive and as expensive as the machinery required for making the cement, and after the marl is dried it has to be carried nearly 60 miles in order to reach the factory. The company owning this plant also owns a large deposit of limestone near Alpena, in the northern part of the State, and if it is decided to change the material of manufacture from marl to limestone, which is a plan in favor with a majority of the stockholders, the stone will be brought by rail or by boat to the plant from this deposit.

In the making of Portland cement by the wet process, one of the most interesting parts of the whole operation is the transformation that goes on inside the rotary kilns from the time the slurry enters until it drops out as clinker. At the upper or elevated end of the kiln is a small hole; in looking through it the slurry that is being fed into the kiln is first seen as a sort of spray, dropping in coarse and fine lumps into the clouds of brownish, lurid steam and smoke that fill the big rotary, and seeming to vanish there. The smoke is dense and thick toward the sides of the kiln, flame and light showing mostly toward the center. At the other and lower end of kiln, where a flame made usually of powdered coal is forced into and through the long tube, nothing but a glare of light can be seen if the eyes are uncovered. It is necessary to use smoked glasses to distinguish objects within the kiln from this end, and when they are used, in looking into the roaring mass of intense heat and flame, it is possible to distinguish small blue-white balls of clinker that seem to leap about hurriedly as they are driven hither and thither by long tongues of fire, but always travel toward the opening at the end of the kiln, through which they finally drop as red-hot clinker. As the huge kiln slowly and steadily revolves at the rate of about one revolution each minute, the larger balls of clinker are broken by falling against its sides, and gravity compels them downward, so that as they leave the kiln, there is rarely a piece to be found larger than an English walnut. After emerging from the kiln, the clinker is cooled, crushed, ground into a fine, almost impalpable powder, and stored in bins, whence it is packed in barrels or sacks for shipment.

To describe in a general way the processes of any one plant where cement is made from marl and burned in rotary kilns is to describe them all, except in so far as they differ in small details. In each case the marl is first put through the hopper of the separator, whether this is done in or out of the factory. It is then conveyed to large storage tanks, where it is kept in a state of agitation by blades that constantly stir it. Meantime the clay or shale has been brought to the mill, crushed, ground, and stored. The marl then is pumped into a vat, where it is thoroughly mixed with clay, and water is added in proper proportions, from which vat a chemist takes samples in order to regulate the proportions of the mixture. In nearly all factories this sampling and testing goes on throughout practically the whole process of manufacture. The mixture, or slurry, is then run into large tanks, being mixed and ground still more thoroughly on its way over the tube mills, and is again tested in its passage. From the vats, where it is kept in motion to prevent it from settling, it is pumped into the rotary kilns, whence it emerges as clinker. About 1 per cent of gypsum is generally added. The buildings covering the machinery for this process are usually of brick, steel, and concrete construction, and the fuel used is nearly always powdered coal.

USES AND PRICES.

The various uses to which Portland cement is constantly being put appear to justify the statement that it is now regarded as among the chief building materials of the twentieth century. It is daily becoming a greater factor in the industrial development of the United States, and nowhere is this fact more forcibly illustrated than in the State of Michigan. The matter of the abolition of grade crossings which is now agitated there has caused thousands of barrels of cement to be used, and in almost every town, even in the very small ones, are found miles of cement sidewalk. It is also used for poles, both for telephone and telegraph service; for piles, railroad ties, foundations for fence posts, and even for the posts themselves; for curbs and street crossings, for smoke stacks, grain elevators, water tanks, sewer pipe, dams, reservoirs, tiles, brick, and for piers, docks, and tunnels. Much important bridge work has been done through the use of cement, in Michigan, and it is largely used in all railroad work done in the State. Nearly all the cement made in the State is of a good quality and has so far stood the test of the years admirably, no failures and few complaints being reported.

The low prices that prevailed during the season of 1903–4 have caused some anxiety to managers of Michigan cement plants. Some of the plants have decreased their output until such time as prices should rise, and the result of this has been that nearly all of the factories running on full time are behind in their orders and can only promise delivery from a week or ten days to two weeks after the order is placed. The advantage of an enormous output is largely governed by the market a plant finds during a dull season or when prices have fallen. For, although a mill producing a quantity of cement sufficient only to supply a comparatively small field might dispose of its entire product at a fair profit, if it manufactured three times the quantity, it would be necessary to enlarge its territory in like proportion to place its output profitably.

In view of the prevailing low price of cement and for other reasons the building of several of the proposed plants in Michigan has been postponed for a year, and several companies that were incorporated have abandoned their projects. Among them are the Zenith Portland Cement Company, which built the foundation of a plant at Grasslake, but failed to interest a sufficient amount of capital to proceed after the fall in cement prices; the West German Portland Cement Company, that was to build a plant near Chelsea, but sold out to the White Portland Cement Company; and the German Portland Cement Company, which proposed to build a plant at White Pigeon.

ACKNOWLEDGMENTS.

In closing a necessarily brief and limited account of some of the most important features of the Portland cement industry in Michigan it is proper to express appreciation of the invariable courtesy extended to the writer during a trip to the cement plants in the State. In no case was information withheld or refused, and the intelligence and cordiality which were met with in each factory visited were a most welcome assistance in gathering the data for this sketch.

PRECIOUS STONES.

By George F. Kunz.

INTRODUCTION.

The increased interest in the production of precious stones in the United States has resulted in bringing together a splendid exhibit of these beautiful products of nature at the Louisiana Purchase Exposition at St. Louis; and many of the States and foreign countries have shown these objects both in their natural state and in their cut form. Indeed, in visiting and studying these successive expositions, it may be remarked in passing, one is impressed, upon seeing the Louisiana Exposition, with the fact that during the last twenty-eight years, from the Centennial to the St. Louis World's Fair, the exhibits of the mining products of the States have gradually evolved from simple collections of ordinary ores into systematic and scientific expositions of the geologic characteristics and mineral products of the States, so arranged as to show the evolution, from the geologic view-point, of the ores, the methods of their working, and the literature pertaining to them. The result is that successively and with varying, though on the whole increasing, fullness at Philadelphia, Chicago, Atlanta, Nashville, Omaha, Buffalo, Charleston, and finally at St. Louis there has been brought together the greatest exhibit representative of the mining and mineral resources of the States ever shown at any world's fair.

The production of precious stones in the United States in 1903 was valued at $321,400; it was valued at $328,450 in 1902, and at $289,050 in 1901.

The total value of the imports of precious stones in 1903 was $26,522,523, as against $24,753,586 in 1902, $22,815,352 in 1901, and $13,561,588 in 1900.

DIAMOND.

SOUTH AFRICA.

De Beers Consolidated Mines.—The reports of the directors and of the managers for the year closing on June 30, 1903, rendered to the general meeting of shareholders in London on November 16, 1903, show great recovery from the effects of the late war and general progress in all departments. The two chief difficulties resulting from the war, as to native labor and African coal, seem to have passed away.

There is no further trouble in obtaining negro workmen, and the African coal mines are yielding freely and are being developed at several new points. The figures of production, as collected in the tabular statements given below, differ but little from those of the preceding year, there being a small general advance, save in the case of the recently opened Bultfontein mine, in which there is large increase. The regular exploitation of the Dutoits-pan mine had not been begun, but was to be undertaken soon.

A considerable part of the report is occupied with detailed statements of the various costs and losses due to the war, the siege of Kimberley, etc., and to the final settlement of claims against the Government thence arising, some of which were allowed, others compromised, and others rejected. The details are interesting reminiscences of the contest in its various stages and its wide extent. The total losses are estimated at £272,904. For more than half of this amount (largely involved in the defense of Kimberley) no claim was made for compensation. There had already been paid £20,806 in cash for horses taken; and £16,924 were paid by the colonial government of Griqualand West. A final claim for £54,641 was presented to the Imperial Government, and this has been compromised for £30,000. It will be seen from the data given that the company lost, in expenses, contributions, and the ravages of war, a total amount of somewhat over a million and one-third dollars.

The dynamite factory—the De Beers Explosives Works—at Somerset West has at last been completed, and is supplying all the material for use at Kimberley. Besides this, contracts are under way for furnishing dynamite for a large part of the mining enterprises in the Transvaal.

The contract with the diamond syndicate has worked favorably, and the diamond market has felt no effect from depression in other industries. The total sales to the syndicate within the year past have been £5,241,172, as against £4,687,194 in the year preceding. The company paid dividends amounting to £2,175,000, as compared with £1,925,000 in 1902. The balance on June 30, 1903, was £746,764, a little less than the balance, £798,686, on the same date in 1902, owing to a very large "writing off" on account of depreciation of property, which was more fully estimated than had been the case for some years previously.

The development of the four main mines has gone on actively. The Bultfontein and Premier have not been opened to any greater depth than last year, 600 and 500 feet, respectively, being the lowest levels worked. The yield of diamonds per load of rock has increased in the Bultfontein from 0.21 to 0.24 carat, and in the Premier has retained its remarkable uniformity of 0.30 carat. The amount of blue ground in sight at these two mines, above the present lowest working levels, reaches the enormous estimate of 14,901,600 loads for the Bultfontein and 16,885,000 loads for the Premier, or, together, 31,786,600.

The following table shows the production of the Bultfontein and the Premier mines in 1902 and 1903:

Production of the Bultfontein and Premier mines for the years ending June 30, 1902 and 1903.

	Bultfontein.		Premier.	
	1902.	1903.	1902.	1903.
Loads of blue hoisted	353,042	318,410	1,932,140	1,987,543
Loads of blue washed	20,194	317,185	1,752,189	1,989,598
Carats of diamonds found[a]	4,486	76,573	521,437	594,890
Value of diamonds found[a]	£6,817	£118,102	£873,203	£1,021,276
Number of carats per load[a]	0.21	0.24	0.30	0.30
Value per carat[a]	30s. 4d.	30s. 10d.	33s. 5d.	34s. 4d.
Value per load[a]	6s. 9d.	7s. 5d.	9s. 11d.	10s. 3d.
Cost of production per load[a]	6s. 6d.	5s. 9d.	3s. 5d.	3s. 3d.
Loads remaining on floors	480,934	482,159	1,573,914	1,571,859

[a] Fractions of pounds, carats, and pence omitted.

The De Beers and Kimberley mines have both been carried down considerably within the year, two new working levels having been added to each of them. The De Beers mine is still greatly hampered by mud rushes, of which there were no less than 29 during the year, causing great loss and delay and in two cases killing native laborers. A new tunnel is being driven around the entire mine in the hard rock below the shale with the hope of taking up the water that causes these mud rushes, as has been successfully done at the Kimberley mine. At the end of the year the blue ground estimated as in sight at these two mines was as follows (in loads):

Amount of blue-ground in sight at De Beers and Kimberley mines June 30, 1903.

DE BEERS.

Level:	Loads.
Above 1,560 feet	1,931,700
Between 1,560 and 1,720 feet	1,995,800
Between 1,720 and 2,040 feet	3,947,200
Total	7,874,700

KIMBERLEY.

Level:	Loads.
Above 1,920 feet	545,800
Between 1,920 and 2,160 feet	1,837,400
Between 2,160 and 2,480 feet	1,896,000
Total	4,279,200

This gives a total for the two old mines of a little over 12,000,000 loads, which, added to the figures above given for the other two mines, aggregates nearly 44,000,000 loads in all.

The rock shafts in the De Beers and Kimberley mines have reached, respectively, the depth of 2,076 and 2,539 feet. The lowest actual working levels are 1,480 and 1,920 feet, respectively. The figures of production are as follows, these two mines being as usual given together in the reports:

Combined production of the De Beers and Kimberley mines for the years ending June 30, 1902 and 1903.

	1902.	1903.
Loads of blue hoisted	2,062,459	2,370,508
Loads of blue washed	1,961,858	2,561,940
Carats of diamonds found [a]	1,499,299	1,574,189
Value of diamonds found [a]	£3,484,247	£3,819,668
Number of carats per load	0.76	0.61
Value per carat [a]	46s. 5d.	48s. 6d.
Value per load [a]	35s. 6d.	29s. 9d.
Cost of production per load [a]	8s. 5d.	7s. 3d.
Loads remaining on floors	2,326,720	2,135,288

[a] Fractions of pounds, carats, and pence omitted.

The fifteenth annual report of the De Beers Consolidated Mines (Limited) for the fiscal year 1903 is as follows:

Fifteenth annual report of De Beers Consolidated Mines (Limited) for the year ending June 30, 1903.

Average yield per load for De Beers and Kimberley mines.......carat..	0.61
Average value per carat for De Beers and Kimberley mines	48s. 6.3d.
Average value per load for De Beers and Kimberley mines	29s. 9.8d.
Average yield per load for Premier mine (Wesselton)...........carat..	0.30
Average value per carat for Premier mine (Wesselton)	34s. 4d.
Average value per load for Premier mine (Wesselton)	10s. 3.2d.
Average yield per load for Bultfontein mine.....................carat..	0.24
Average value per carat for Bultfontein mine	30s. 10.2d.
Average value per load for Bultfontein mine	7s. 5d.

It will be seen that, with all the general advance in production and profit, the yield per load, after rising, has again seriously fallen. This is attributed in the report mainly to the intermixture of mud with the blue-ground, caused by the mud rushes in the De Beers mine. It is, however, very suggestive to see the yield per load at the lowest figure yet reached, and less than half of what it was in 1889, when the work of the Consolidated Company began.

This falling off in the yield per load continues to be more than counteracted by the steady rise in the value of the diamonds contained, which is nearly two and a half times what it was in 1889; so that the actual value of a load has increased. In the fifteen years since that time the yield per load has fallen from 1.283 carats to 0.61; the value per carat has risen from 19s. 8d. to 48s. 6d., and the value of a load has hence made a net advance from 25s. 3d. to 29s. 9d. The two newer mines show a general small advance, and costs are diminishing with improved appliances and with the passing away of the embarrassments due to the war.

Comparing the figures in these respects for the several mines, the facts may be tabulated as follows (omitting fractions of pence):

Ratios of yield and value at the De Beers Consolidated Mines, for the year ending June 30, 1903.

	Mine.		
	De Beers-Kimberley.	Premier.	Bultfontein.
Average yield per load.....carat..	0.61	0.30	0.24
Average value per carat.....	48s. 6d.	34s. 6d.	30s. 10d.
Average value per load.....	29s. 9d.	10s. 3d.	7s. 5d.

To give an idea of the immense total production from the group of mines controlled and operated by this great company the following figures have been compiled from the tables for the several years presented in the report. Of course even these results do not give the total of diamond production in South Africa, as large quantities were obtained in the years prior to the formation of the consolidated company, and both before and since that time other mines in the Orange River and neighboring districts have yielded considerable quantities. But the main output from the Kimberley mines under the present management is as follows:

Total yield from the De Beers mines since the consolidation in 1889 to June 30, 1903.

Mine.	Diamonds produced.	Value.
	Carats.	£ s. d.
De Beers and Kimberley.....	30,550,057	46,170,993 9 1
Premier (7 years).....	2,470,609	3,535,523 13 6
Bultfontein (3 years).....	81,124	125,065 8 7
Total.....	33,101,790	49,831,582 11 2

A sum therefore of nearly $250,000,000 expresses the value of the diamonds hence derived and added to the world's wealth in the last fifteen years. This amount (sales through the syndicate), however, large as it is, represents the uncut stones only. Their commercial value is fully doubled in the process of cutting and polishing for use.

In addition to the report of the assistant general manager, Mr. Alpheus S. Williams, and the tables of accounts, there are included the addresses made at the shareholders' meeting by the chairman of the directors, Sir Lewis Loyd Michell, and by Mr. Julius Wernher, one of the two surviving life governors of the company, both of which are occupied with the discussion of important aspects. Mr. Wernher has recently visited the mines after an absence of many years, and has much of interest to say of the extraordinary changes that he found in all the conditions. He refers at some length to the rise above noted in the market price of diamonds, showing that it has practically doubled in the course of twenty years. On this head he says:

There is another important and very pleasing feature, and that is the price which we obtain for our diamonds. Before leaving London I happened to come across * * * an old statement giving the statistics of the company from 1883. * * * Going back twenty years, to the time when I left Kimberley in 1883, I find that the whole production of the district of Kimberley at that time was 2,413,953 carats, yielding £2,742,521, or £1 2s. 8d. per carat. This was the production of the whole of the district.[a] The figures for the succeeding years will show you the results of Mr. Rhodes's policy. The amalgamation was effected * * * five years later; * * * not every mine was then included, but we may say that in 1888 the change to the one big company was brought about. In that year we produced, in round figures, 3,800,000 carats, for which we obtained £4,000,000, or £1 1s. per carat. In the following year, when the effects of the amalgamation became more apparent, we produced * * * less—2,900,000 carats instead of 3,800,000—for which we obtained £4,300,000, or £1 9s. per carat.

Well, I will not trouble you with the whole of this list, but I will come at once to the year just ended, in which we produced 2,400,000 carats—practically the same amount as in 1883, but although in 1883 we obtained only £2,700,000, we obtained for our present year's output £5,240,000, or £2 2s. 5d. per carat. The results are in fact slightly better than that, because included in our present output we have a large quantity of tailings, which * * * yield, comparatively speaking, only a small price, but if we take the stuff as it comes from the mine our average is really £2 4s. per carat, as against £1 2s. twenty years ago. These are very remarkable results, of which, I think, we may well be proud. * * * I might further point out that in the old returns of which I have been speaking, there was a large proportion (20 per cent or nearly so) of Dutoits-pan stuff, which always yielded a much higher price than the produce of the other mines, and we did not at any time carry on the amount of fine sorting which now takes place. Consequently the real increase is very much more than appears from the figures I have quoted.

It will be seen from these statements that the price has been gradually advanced, largely by a judicious system of limitation of output made possible by the consolidation. The great Dutoits-pan mine, for instance, here alluded to as of exceptional richness in point of value of product, has been unworked for years; and though it is proposed to open it again ere long, this may very likely depend upon the conditions of the diamond market.

The dividends of £2,175,000 above mentioned consist of the following items:

Dividends of De Beers Consolidated Mines (Limited) for year ending June 30, 1903.

Dividends for half year ending December 31, 1902:		
10s. per share on 800,000 preference shares of £2 10s. par value	£400,000	
12s. 6d. share on 1,000,000 deferred shares of £2 10s. par value	625,000	
		£1,025,000

[a] Mr. Wernher includes not only the mines now operated but the others in the same district, some of which have been long kept closed.

Dividends for half-year ending June 30, 1903:		
The same dividends on same stock of both kinds......	£1,025,000	
Additional bonus of 2s. 6d. on deferred shares.........	125,000	
		£1,150,000
Total dividends and bonus for the year........................		£2,175,000

Transvaal diamonds.—In the report of this Bureau for 1900[a] reference was made to the diamond mines in the Transvaal, and some data were given up to the outbreak of the war. Within the year past important and extensive developments have been made in this district, and it is clear that diamond deposits of a character similar to those of Kimberley and of very promising richness exist throughout a wide area to the east of Pretoria. Many mines have been located, and something like 100 prospecting shafts have been sunk to varying depths to test the nature and the extent of the deposits. These resemble in general those of Kimberley—a red surface soil, then yellow ground, and then blue ground. The red clay is very rich in diamonds, presumably from its being a residual material concentrated through an indefinite period; the yellow ground is poorer, and the value of the blue ground is yet to be proved. Thus far, however, the output has compared not unfavorably with that of the De Beers property—superior to it in yield per load, but inferior in size and quality of the stones obtained.

Among the mines actually in operation by far the most important is the Premier (not to be confounded with the De Beers Premier). This is an immense mine in area, representing between 3,000 and 4,000 claims of 30 by 30 feet each. This, however, is the upper or superficial portion, and the actual size of the "pipe" is yet unknown, though it must be, of course, very much less. The company operating this mine began work in May, 1903; from June to October, inclusive, the monthly output advanced from 14,619 carats to 22,549, the number of carats per load varying from 1.03 to 1.47, the ratio for October being 1.28. This is like the ratio at Kimberley in the earlier years, which for two years past has been only 0.76 carat per load. On the other hand, the average recent value of De Beers and Kimberley stones is $11.62 per carat, while the new Premier diamonds bring only about $6.75. There are estimated to be 20,000,000 loads in sight at the new Premier, but it is pointed out that, with these figures as to value, the De Beers Company is in control of the situation and that a reduction in price on their part of several dollars per carat would still leave them a good profit, while it would almost obliterate the profits of the new Premier. This may come to pass, it is thought, if the Transvaal development continues as it appears likely to do.

The mines in this district are operated under a law which assigns

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[a] Production of precious stones: Extract from Mineral Resources U. S. for 1900, U. S. Geol. Survey, 1901, p. 11; Jour. Soc. Arts, October, 1899.

six-tenths of the area to the State and four-tenths to the private owner or owners, the latter supplying the capital for working, and the net profits being divided in the same proportion. The State therefore becomes the controlling partner, and no repetition of the Kimberley process of buying up minor claims and consolidating all into one great corporation is possible in this new area. This law went into operation in July, 1903, and is in general much more liberal than the laws of the Transvaal Republic, though some owners do not like certain of its provisions as well.

The new Premier mine yields about four-fifths or more of the entire diamond production of the Transvaal, though there are numerous smaller and experimental workings. The total production for the year 1903 up to November, inclusive, increasing greatly from month to month, is reported to be 144,573 carats, valued at £197,569.

Diamond mining in the Vaal district.—An interesting article was published in the Engineering and Mining Journal in September, 1903, by Mr. T. Lane Carter, on diamond mining as now in progress in the old Vaal district, where the first excitement developed about African diamonds, at the so-called "river diggings," before Kimberley was founded, or the "dry diggings," whence it arose, were known.[a] The whole region has been searched over and turned up by prospectors, and some are still to be found at work. This universal digging over has had two results; on the one hand, it has made the geological structure very easily observable—everywhere a bed of sand and gravel from 5 to 20 feet thick, full of bowlders of basalt and melaphyr, and resting on the limestone layer that forms the uppermost rock of the country. In this gravel bed the diamonds are found, with more or less of pyrope garnets and peridots, but very unequally distributed, so that working at any particular point is a veritable game of chance. Upon this gravel originally reposed a thin bed of surface soil, but the removal of this layer by the widespread digging has made this whole portion of Griqualand West a hopeless desert, in which agriculture is impossible from the absence of soil.

But the most interesting feature of Mr. Carter's article is his account of the existence and present working of a large and genuine "pipe" mine similar to those at Kimberley, in the heart of the Vaal River diamond country. This is doubtless the source, or one among several sources not yet discovered, of the diamonds of the "river diggings." It presents identical features with the Kimberley pipes, so far as it has been opened—a limestone capping 5 or 6 feet thick, underlain by yellow ground and then by blue. This last is much like that of the De Beers mines, though quite distinguishable. It often contains large bowlders and is a good deal broken up with dikes. Mr. Carter remarks upon the presence of diamonds in the limestone as indicating that this rock was produced by infiltration from below, "after the formation of

[a] Carter, T. Lane, The diamond district of the Vaal River: Eng. and Min. Jour., Sept. 5, 1903.

the diamonds." It is not easy, however, to see how diamonds could have been carried upward by "infiltration;" and this peculiar occurrence must await explánation by further study of the structure of the limestone cap. If it is a travertine, as Mr. Carter's view would imply, the diamonds must represent a residuum left from the previous atmospheric erosion of the upper part of the yellow ground.

The area of the pipe is very large, though its extent is not stated and is perhaps not accurately known. Two companies are at work upon it, of which the larger, the Elandsdrift Diamond Mining Company, has in its employ about 30 white men and 250 Kaffirs. As yet the work is all by open cuts and has not gone below about 200 feet. The outside shaft method pursued at Kimberley will in due time become necessary, as caving-in is already causing trouble, but it will be delayed as long as possible on account of its cost.

The production is not extensive, and the stones are for the most part small, the larger ones ranging only from 4 to 8 carats, but they are of fine quality, very white, pure, and brilliant, and bring $25 a carat or even more. In these respects they resemble those of the river diggings; their aspect is characteristic and unmistakable, quite distinct from Kimberley stones, and they often present a peculiar laminated appearance. Every two weeks the output is taken to Kimberley, about 20 miles distant, and sold to the diamond syndicate.

The mine is a moderate success on account of the high quality and value of the stones, but these are not very abundant in the blue. Hence it is what is termed a low-grade mine, and Mr. Carter thinks it would be much more profitable if operated on a large scale like the De Beers mines. The working is all by hand and also the sorting and picking, the grease separator not being used, although it has been found to be so much cheaper at Kimberley. Down to the present depth, 200 feet, the blue is quite soft and does not need any drying floors. It is taken directly to the washing plant and crushed between rollers before being washed. The concentrates are very like those at Kimberley, though with rather more colored minerals, as olivine, serpentine, etc.

The natives are dealt with much as in the De Beers mines, with a compound system rather less strict. Wages are about the same, averaging $5 a week. The distance from the railroad (12 miles) involves some additional cost as compared with Kimberley in the necessary hauling of all kinds of supplies.

The whole account of this new "pipe" is highly interesting from a scientific point of view, whatever may be its practical results.

Mechanical equipment of the Kimberley mines.—Mr. Charles V. Allen, in a recent issue of the Engineering Magazine,[a] has given a

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[a] Allen, Chas. V., The mechanical equipment of the Kimberley diamond mines: Eng. Mag., November, 1906, New York, pp. 177-192.

very extended account of the whole great system of modern engineering appliances in use at the various mines and establishments operated by the De Beers Company in South Africa. This sketch includes not only the diamond mines at and around Kimberley, but the De Beers Explosive Works, at False Bay, near Cape Town, and other accessory plants. Mr. Allen notes the fact that the last year has witnessed many changes in the work of operating the mines, made necessary to a large extent by the increased depth attained, and he gives first place to the great extent to which electrical machinery has been introduced, not only at the mines but in all the works and holdings of the company. His article, indeed, consists chiefly of descriptions of the electrical apparatus, illustrated by numerous half-tone figures.

The account is a very remarkable one in its exhibition of the power and variety of electrical machinery already installed in the vast and varied activities of this immense corporation. To give any particulars in a brief notice like this is of course impossible. The power houses, the various machine shops, and the different kinds of motors employed are all described in some detail and their manner of use in the several parts of the mining and hauling operations. In the machine shops the smaller tools are now for the most part run by separate motors, each motor operating a group of several tools or machines of like character, as lathes, scrapers, screw machines, etc., thus doing away largely with shafting and belting, and resulting in much economy. Powerful narrow-gage electric locomotives are being introduced for ore hauling on inclines, etc., all of which are described and some figured, as are also the elaborate arrangements at the False Bay explosive works.

Mention is made of the fact that African coal is now being freely obtained and is giving much satisfaction. The interruption of this native supply during the late war caused great embarrassment and expense to the De Beers Company, but now the Indwe mines are yielding an output of 12,000 tons per month, of which 5,500 are taken by the De Beers Company. The calorific power of this coal is only about 60 per cent as compared with Welsh coal; but the difference in cost of supply much more than counterbalances this defect. About 1,000 tons a month from the Stormberg district are also used by the company.

INDIA.

Mr. Sarrat C. Rudra, a member of the American Institute of Mining Engineers, Calcutta, India, presented at the New York meeting of the Institute, October, 1903, an admirable paper[a] on the mineral resources of India, which treated of the past, the present, and the future possibilities of that great oriental country. Of especial interest are his references to the precious stones.

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[a]Trans. Am. Inst. Min. Eng., New York Meeting, October, 1903, pp. 11-15; Table III, p. 26.

Mr. Rudra refers briefly to the sapphires of Cashmere, and he gives an interesting review of the diamond mines of India, basing his paper on the writings of Saurindro Mohun, Maharajah of Tagore, Marco Polo, Tavernier, and Ball.

In regard to occurrences, localities, etc., of the diamond, Mr. Rudra says that this pure crystalline form of carbon has played a very important part in the history of ancient and modern India, and that references to this mineral are found in many of the ancient Sanskrit writings of India, in which names of localities where diamonds were found are also given, although to recognize some of these localities is rather difficult owing to changed nomenclature. The Maharajah of Tagore[a] has tried to establish the identity of these localities with fair success.

Karl Ritter suggests in his work[b] that the Arabs and the Phoenicians had a regular trade in diamonds with India. He also found evidences that the trade existed in the time of Solomon and even of Moses. In addition to Marco Polo, much information regarding diamonds in India has been published by Tavernier,[c] Fitch,[d] and Newbury.[d]

The name "Golconda diamonds" though derived from the town of Golconda near the city of Hyderabad, was used for the stones obtained from the extensive regions comprised in the provinces watered by the Krishna and Godavari rivers. The stones were collected and polished in the town of Golconda.

Besides Golconda, the other localities in the same neighborhood where diamonds were formerly mined, are Cuddapah, Bellary, and Kurnul.

The diamond-producing fields in India may be divided roughly into three sections:

1. Southern: Golconda or Telingana, including the five modern districts of Cuddapah, Kurnul, Bellary, Krishna, and Godavari (Bhadrachalam).

2. Middle: Includes the large tract of country between the rivers Godavari and Mahanadi. In this section diamonds are still found near Sambhulpur and Warragurh. There are also two or three localities within Chota-Nagpur where diamonds are occasionally found in river beds.

3. Northern: Includes the country known as Bundelkhand, in which is situated the district of Panna. In the country surrounding Panna diamonds occurring in place are being mined regularly.

In northern India diamonds occur in the Rewah group of the upper Vindyan formation, and in lower India, Madras Presidency, in the Kurnul (Silurian?) formation. The geological strata of northern and southern India as described by Valentine Ball[d] are as follows:

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[a] Mani Mala, 2 vols., Calcutta, 1879.
[b] Erdkunde Asiens, vol. 6, p. 343.
[c] Voyages, vol. 2, Paris.
[d] Selections from the records of the Bombay Government, vol. 8, 1853.

Geological formations of northern and southern India.

Northern India.		Southern India.
Upper Vindyan series	Bhaurer group	Absent.
	Rewah group (diamond)	
	Kaimur group	
		(Known as the Kurnul formation.)
Lower Vindyan section	Tirhowan limestone	Khundair shales and limestone.
	Palkoa shales	
	Dalchikur sandstone	Panceun quartzite.
	Semri shales and limestone	Jamalmadgu shales and limestone.
	Semri sandstone	Banaganpilly (diamond).

So far as known, the occurrence of diamonds at Panna is limited to the Rewah group, being found in place in a conglomerate rock, and in alluvial and superficial deposits. The Rewah bed extends over a large area, but no search for diamonds has been made elsewhere than at Panna. Diamonds are sometimes found included in pebbles.

In Chota-Nagpur and Sambhalpur, diamonds are found in river beds, from which they are obtained by some low-caste tribes in the following primitive manner: After a rainy season, the Mahanadi River near the town of Sambhalpur becomes low, and a large number of the members of these tribes begin to dam the north channel of the river between an island and the bank. Later, when the river gets still lower, the gravel included in this dam is collected and carried to a dry place, where it is washed for gold and diamonds. The quantity of gold obtained is very small indeed, and may be barely enough to pay for the daily meals of one person, but sometimes the washers are rewarded by the find of a good-sized diamond, which may keep a family in ease and comfort for years. The diamonds found in this river bed have evidently been brought down from a higher source, perhaps from the headwaters of the Mahanadi River, and a thoroughly equipped prospecting expedition would doubtless find their matrix.

In the southern Golconda region, diamonds are found in gravel beds composed of rolled stones of various sizes, intermixed with mud. The pebbles are ferruginous schistose sandstones or sandstone-conglomerates, and include also quartz, chert, jasper, claystone, porphyry, feldspar crystals, blue jasper veined with iron oxide, red jasper, and quartz crystals.

Reports of the finding of diamonds near Simla in the Himalayas are very interesting. The older Paleozoic rocks somewhat resemble the southern Kurnul (Silurian?) formation. It is, therefore, likely that diamonds may also occur in this locality.

It is interesting to note that whereas at one time the mines of India produced all the diamonds of the world, now more diamonds are produced in the De Beers mines in one hour than are produced in the entire Indian Empire in a year. The garnet production of India is four times that of the diamond in value.

NEW SOUTH WALES.

In the annual report of the department of mines of New South Wales for 1903 the estimated quantity of diamonds found during the year is given as 12,239 carats, valued at $49,930, an increase of 244 carats, but a decrease of $6,690 in value, as compared with the output of 1902, a considerable decline having occurred in the price of the stones.

NOTES ON THE DIAMOND.

ELECTRIC PECULIARITIES OF THE DIAMOND.

Specific gravity, hardness, and quantitative analysis by combustion with oxygen, have hitherto been held as the necessary requisites for the certain identification of the diamond.

Very recently Prof. Alexandro Artom, of Turin, proposed that a number of electric phenomena, of which some appear quite characteristic, be added to the distinguishing features above mentioned, as in a measure complementary and of equal importance.[a]

The specific electrical resistance of the diamond is about the same as that of ordinary glass; it lies, according to the values calculated by Artom, somewhere between 0.2 and 1.3 by 10^{12}.

It is worthy of note that graphite, the allotropic form of carbon, into which the diamond is transformed at very high temperatures, possesses 10^{15} times as great a conductivity. Subjected to the Roentgen rays the diamond has its conductivity increased twofold, but the original value returns immediately upon the removal of the beam. Like ice, the diamond also possesses a dielectric constant, which is much greater than would be expected. Theoretically, it ought to be 7; in reality, however, it lies somewhere between 10 and 17. This may be taken to indicate that the diamond, as is the case with ice, retains the dielectric constant of a former fluid state after it has become solidified. It is possible also that certain hydrocarbons, such as CH_2 and CH_3, are present in small quantities in the diamond, and that the augmentation in the dielectric constant may be ascribable to them.

The diamond, moreover, discloses a certain amount of permanent polarization and electric hysteresis. Besides, it is very weakly paramagnetic and pyro-electric.

DIAMONDS USED IN WIRE-DRAWING.

Among the uses to which diamonds are applied in the industrial arts, one that is known only to the trade but is of considerable importance is in the process of wire-drawing. For this purpose both diamonds

[a] Academia Reale delle Scienze di Torino. Anno 1901-1902. Ricerche sulle Proprietà Electriche del Diamante. Nota Alessandro Artom. Torino, Carlo Clausen, Libraio della R. Academia delle Scienze, 1902.

and bort are employed to make what are called wire dies—a round polished hole being drilled in the stone.

In reply to inquiries by the writer, a letter from Mr. J. H. O'Donnell, of Waterbury, Conn., gives some interesting particulars. The demand for such dies is quite large, chiefly of sizes between 0.008 and 0.040 inch. Stones from 20 carats down to one-fourth carat are used, rarely anything smaller; and the total quantity of diamonds so used during the year ending July, 1903, amounted to 4,000 carats, of various grades. Clear bright diamonds are preferred for steel wire, as they last longer than inferior stones. A die of this kind, 0.010 inch in aperture, does not show wear until it has drawn from 500 to 1,000 pounds of wire. Off-color diamonds and bort are used for copper, brass, and alloys. The bort should be flawless, and, if round, it is flattened or cleaved so as to have two flat sides. A first-rate die of this character will "hold to size," 0.030 inch, for as much as 300,000 pounds of brass pin wire. For copper wire, dies have been known to last through five years of steady work, though the average life is only about half that time; this is for wire of 0.036 inch: the smaller sizes wear out more rapidly.

CORUNDUM GEMS.

CORUNDUM.

NORTH CAROLINA.

In connection with the early history of sapphires, it is interesting to note that Prof. Daniel S. Martin, while recently rearranging the collection in the College of South Carolina at Columbia, S. C., found several specimens of corundum collected by the late Prof. Richard T. Brumby from Clubb Mountain, Lincoln County, N. C., in 1852. Professor Brumby arranged and labeled this collection in the early fifties, and a particular record of date and locality is made in his own handwriting. These are perhaps the first specimens of North Carolina corundum definitely placed in a public collection, and Professor Brumby was evidently one of the first to recognize this mineral in the State.

BERYL AND EUCLASE.

BRAZIL.

Considerable interest has lately been manifested in the mining of beryls and tourmalines in the province of Minas Geraes, Brazil, and a number of remarkable blue and green beryls have been obtained. One of the latter was a crystal weighing 224 ounces (18⅔ pounds) slightly weather worn, and another weighed 5 pounds, both of a rich greenish color. The larger crystal of these is more than twice the weight of the great beryl in the Imperial Mining Institute at St.

Petersburg, Russia, which weighs 8 pounds, and is a perfect doubly terminated crystal, valued at the time of its finding at $13,000. During 1903, a remarkable discovery of blue beryls was made at a station on the Leopoldina Railroad, northwest from Rio de Janeiro. These were deep blue crystals, from which single gems were cut weighing as much as 100 carats each, an extraordinary size.

During some mining carried on for gems at Villa Rica, Brazil, some two dozen magnificent crystals of euclase were found, measuring from 10 to 33 mm. in length (two-fifths to 1⅓ inch). A number of these were unfortunately broken in removal from the rock; and it is greatly to be regretted that some local lapidaries, in endeavoring to improve these broken crystals, destroyed their crystallographic value by polishing the natural faces.

GARNET.

ESSONITE.

CALIFORNIA.

Essonite has been found at a number of localities in deposits spread over a considerable territory from 9 to 10 miles northeast of Jacomba Hot Springs, San Diego County, Cal., usually associated with granite and granular limestone. At three of the places some gem material has been found. Associated with it is a little vesuvianite and crystallized quartz. Eleven localities in this region are noted by Mr. W. H. Trenchard, of San Diego, Cal. Essonite has also been found near San Vicente, El Cajon Mountains, but the crystals were full of imperfections. The finest essonite crystals are obtained at Ramona, San Diego County, associated with green tourmaline, white topaz, and beryl, occasionally in perfect dodecahedrons and trapezohedrons, of rich yellow to orange-red color, and very brilliant. They have also been discovered at Warner's ranch, Mesa Grande, Santa Ysabel, Gravilla, and Julian, San Diego County; Deer Park, Placer County; Laguna Mountains and Jacomba, and also at several places below the Mexican line. As some of the crystals were of exceptional brilliancy, it is possible that on further development many fine gems will be obtained.

PYROPE.

KENTUCKY.

The peridotitic dikes of Elliott County, Ky., which at one time were thought of as a possible source of diamonds, from special resemblances in their occurrence to that of the rock at Kimberley, South Africa, have recently been yielding some fine pyrope garnet and olivine of gem quality, both of which species are characteristic of peridotite. They were observed and collected here nearly twenty years ago, when the region first came into notice, by Prof. Edward Orton, Mr. A. R. Crandall, Prof. Carvill Lewis, and the writer,[a] but have not attracted much attention of late. Mr. C. W. Hall, of Minneapolis, now states, however, that Bohemian garnet (i. e., pyrope) is being found in Elliott County in considerable quantity, though he does not say how far it is of gem quality.

Some pyropes have also been obtained from the similar peridotite dike at Highland street, Syracuse, N. Y., referred to in the report of this Bureau for 1901. These are noted by Mr. P. A. Schneider, of Syracuse, who has given much study to this remarkable and isolated group of peridotite intrusions.

TOURMALINE.

CONNECTICUT.

The fine gem-tourmalines of Haddam Neck, Conn.,[b] are obtained from an albite quarry at that point, situated a few rods from the east bank of the Connecticut River, and at some elevation above it. The albite occurs here as a great vein, or more probably dike, outcropping with a north and south strike and a nearly vertical dip. There are two points where openings have been made. The main quarry is an excavation about 95 feet in length and 50 feet in width, and has been carried down some 40 feet in snow-white feldspar; the other lies a hundred yards to the southwest, and shows an outcrop of perhaps 130 feet long and 26 feet wide; only a few trial openings have been made here; the feldspar in this quarry is very pure, but slightly yellowish. In both places the depth of the dike is unknown. It probably extends downward indefinitely. At the main quarry, the excavation has followed down the west side of the dike, where it meets the gneiss rock of the region, but though extended eastward for 50 feet, the opposite wall has not yet been reached.

The gem-tourmalines occur principally near the eastern border of the dike, in a zone of 2 or 3 feet wide, where the feldspar is largely intermingled with other minerals, chiefly quartz, potash-mica (muscovite), and lithia-mica (lepidolite), garnets, black tourmalines, and several other species of less value. The colored tourmalines are chiefly green, but many are pink, and even red (rubellite), and various tints are often curiously and beautifully present in the same crystal. They frequently penetrate the quartz crystals, and are also in the mica and in the albite, but the finest crystals are those from cavities or pockets, where they have had space to develop independently.

The mine has been worked somewhat irregularly for three or four

[a] Gems and Precious Stones of North America, pp. 31, 32.

[b] Mineral Resources U. S. for 1902, U. S. Geol. Survey, 1904, p. 841. 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.

years of late, though not since 1901. It has been operated principally for the feldspar, which was at first shipped to pottery works at Trenton, N. J.; but later the product has been taken and ground up by the Bon Ami Company for their various polishing uses. Some 1,200 tons have been taken out, and about ten times that amount is estimated to be in sight. Mr. M. P. Gillett, the owner and principal manager of the mine, states that it was recognized as a valuable property as much as sixty years ago, and proposals were made to operate it, but nothing was done, for various reasons, until 1896. In the next year one of the cavities was encountered and blown out, with the result of finding pieces of a peculiar green mineral in the débris. These were not recognized, but Mr. Gillett showed them to Prof. William N. Rice, of Middletown, Conn., and to Mr. Ernest Schernikow, of New York, who at once perceived their interest and value. The latter became associated in operating the mine, and subsequently leased it for the entire season of 1901.

A large number of very beautiful gem-tourmalines were obtained, and many fine stones cut from them, besides an extensive yield of choice mineralogical specimens, which have gone into both public and private collections near and far. The museum of Wesleyan University at Middletown, Conn., possesses a very fine series of these tourmalines, gathered by and through Professor Rice. Mr. Schernikow presented a set of 80 representative specimens from this mine, comprising 10 species, to the museum of Oxford University, England. These have been described quite fully by Mr. H. L. Bowman in the Mineralogical Magazine (London) for May, 1902.[a]

MAINE.

The tourmalines from Rumford Falls, Oxford County, Me., are mined on the side of a densely wooded mountain, at an altitude of 2,511 feet above the sea. The exposed pegmatite dike in which they occur is 5 feet thick and has been traced for 300 feet. Work is being done by tunneling, and the best material is taken out at a depth of 25 feet below the surface. The color improves with the depth at which the material is mined, and over fifty pockets have been found containing fine, clear gem crystals, from one of which has been cut a stone of 16 carats. The varieties found include green tourmaline, the colorless achroite, the red rubellite, and the dark blue indicolite. The associated minerals of the locality are quartz, feldspar, mica, lepidolite, amblygonite, and a pale lilac spodumene resembling the variety kunzite, but opaque.

[a] Mineralog. Mag. and Jour. Mineralog. Soc., vol. 13, No. 60, May, 1902, pp. 97-121, pl. 4.

JADE (NEPHRITE).

GERMAN NEW GUINEA, SILESIA, AND ELSEWHERE.

The recent discoveries of jade and the archæology of the subject are of great interest. The most important contribution to the subject that has appeared during the last decade is the article[a] of Herr Geheimrath Dr. A. B. Meyer cited below, who gives a thorough yet concise résumé of the discoveries and publications concerning jade since 1891. It is a continuation of the two volumes prepared by Doctor Meyer and published by the Royal Saxon Museum in the year mentioned, and with them forms a noteworthy account of the history, technology, and archæology of jade and allied minerals so far as present knowledge goes. Doctor Meyer has published in all no fewer than 36 articles on the general subject, and, as is well known, has clearly shown that the subject is a chemical rather than an ethnological problem.

Three distinct regions have furnished most of the material discussed in the present memoir.

First. The Humboldt Bay, Astrolabe Bay, Saddle Mountain, and Collingwood Sound districts of New Guinea. A full discussion of the nephrite from this general area is given, and attention is called to the use of the material from this section for implements, notably axes, several of which are illustrated. A remarkable flat ring, 4 inches in diameter, recalling some peculiar Chinese forms, is also described and figured.

Second. The Jordansmühl locality in Silesia, in which Kunz discovered in situ the mass of nephrite, weighing 4,715 pounds, now in the Bishop collection. The occurrence also in this vicinity of nephrite bowlders and the finding of flat jadeite axes are fully discussed, as are the frequent misstatements that have been made regarding transportation of jade, nephrite, and chloromelanite by tribal wanderers and its influence on the distribution of adzes of those materials. Doctor Meyer concludes that the value which such objects are supposed to have had among prehistoric peoples is overestimated.

Third. The occurrence of jadeite, nephrite, and chloromelanite in other localities is discussed at length. The discoveries noted included those of nephrite pebbles in the river Sann, at Cilli, Styria; from the Mur, in the vicinity of Graz, and at other points in Austria; those at Monte Viso, at Lake Geneva, at St. Marcel in Piedmont, and in the Val d'Aosta (which last have been shown to be jadeite). The jadeite pyroxene from Piedmont; a rough mineralogical specimen from the Rivoli in Piedmont, at the entrance of the Val d'Aosta, and Heierli's

[a] Zur Nephritfrage (Neu Guinea, Jordansmühl u. a., Alpen, Bibliographisches), von Dr. A. B. Meyer, Direktor des Museums: Abhandlungen und Berichte des Königlichen Zoologischen und Anthropologisch-Ethnographischen Museums zu Dresden, vol. 10, Nr. 4, Berlin, R. Friedländer & Sohn, 1903. Folio, 82 pp., 2 pl.

discovery of nephrite and saussurite in pebbles as well as in the rock in place in Canton Wallis in the central Alps, are also noted. In view of these and other well-defined European occurrences, Doctor Meyer asks, "What shall one say when, as late as 1902, an author who has given much attention to the whole nephrite subject can write: 'The question is still unsolved whether the nephrite objects found in the pile dwellings of Lake Constance (which would require tools and considerable skill to make) have come from distant Asia (China, Tibet, and Turkestan), or, as many believe, owe their origin to the Swiss Alps. It is left for the further solution of the nephrite question to determine whether the inhabitants of the lake dwellings—perhaps before their migration from Asia—possessed the knowledge and the use of nephrite and brought the latter to Europe, or whether it was obtained through importation.'"

Dr. A. B. Meyer has also lately presented another article, "Neue Mitteilungen über Nephrit," in Globus[a] describing the occurrence of nephrite in New Guinea. In this he states that after giving a description of the nephrite axes from the Saddle Mountain region in the north of Huon Gulf, German New Guinea (in Abh. u. Ber. Mus. Dresden, vol. 10, 1903, Nr. 4, s. 9ff.), he wrote to his correspondent to ascertain whether it was possible for him to procure specimens in their natural state from the region where the axes had been obtained. His correspondent replied that in his voyages on the Waria and the Hercules rivers, in the south of Huon Gulf, he had found in pieces of various sizes in the large sand banks the material out of which these stone axes had been made. He adds, also, that the pieces must have traveled a great distance, as they were entirely smooth and partly polished, with no sharp edges visible. On inquiring of a native how the stone axes were made, the latter seized a piece of nephrite and striking it with a similar one immediately separated it into two smooth long pieces. One of these pieces was struck again, and it again separated as before, and into the form and thickness of one of the stone axes, only requiring further the trimming of the edges. Not all the material, however, is of such texture that axes can so easily be made, as in another locality the correspondent found that the stone did not so readily break in this way. He remarks that the natives have an experienced eye for determining whether the material is well breakable or not. This native manufacture is not carried on any more, because all the axes and adzes that are now used are of commercial iron and steel, which are sold throughout the entire world for a trifle of the cost at which the stone axes can be made. The region of the Hercules River is not yet known, so that it is impossible at present to state what is the real home of the material. It has possibly

[a] Globus: Sonderabdruck aus Band LXXXVI, Nr. 4 des., s. 53–55, 1904.

been carried by the river from the Albert-Edward Mountains, or from the hills between the latter and the Bismarck Mountains. It is an interesting fact that the nephrite has been also observed in the other side streams of the Huon Gulf, showing that it must occur at a number of localities in that general region.

In a description of the quarry where nephrite is found at Jordansmühl, Silesia, Dr. A. von Sachs presents a paper in the Centralblatt für Mineralogie[a] describing fully this remarkable locality. It was at this locality that the great mass of jade weighing 4,715 pounds, now in the Heber R. Bishop collection at the American Museum of Art was found by the writer, who collected with it a large series of the associated minerals and rocks, photographing the quarry and its various points of interest. These will appear fully in the great catalogue of the Heber R. Bishop collection, which catalogue, now in press, is likely to appear within the next year or two.

Dr. von Sachs says that the celebrated quarry of Jordansmühl near Mount Zobten, the place where the nephrite is found, is situated at the opening of the great plateau extending between Jordansmühl and Naselwitz. It consists mainly of serpentine, but shows also certain white masses of rock, and on the boundary between these and the serpentine is frequently observed the nephrite.[b] Traube chose this subject (as "sogenannten Weiss-stein") for his inaugural dissertation,[c] evidently accepting the observations made by J. Roth, who called the same rock occurring at Mlietsch, south of Jordansmühl and east of the mountain, Weiss-stein, while in the above-mentioned treatise on the nephrite of Jordansmühl he has called it granulite. But the definition of the latter does not correspond with the rock found at Jordansmühl. In the first place, it is remarkable that there is no parallel structure, as likewise observed by Roth on the Weiss-stein of Mlietsch; further, some varieties of the Jordansmühl Weiss-stein do not contain feldspar at all; and lastly, the chemical composition is quite different from that of granulite. The typical granulite, also, does not contain mica, which Traube observed in the nephrite. (Über den Nephrite v. Jordansmühl, s. 414.)

Consequently, the questions to answer are: What is the Weiss-stein of Jordansmühl, its origin, and its relations to serpentine?

Before undertaking to answer these questions Doctor von Sachs studied carefully in every detail the Jordansmühl localities. Samples were taken from twenty-six different parts of the quarry, and about one

[a] Der Weiss-stein des Jordansmühler Nephritvorkommens, by A. von Sachs, Breslau, with 4 text figures. From Separat-Abdruck aus dem Centralblatt für Mineralogie, Geologie, und Palæontologie, 1902, pp. 335-396.

[b] H. Traube, Über den Nephrite von Jordansmühl in Schlesien, N. Jahrb. für Min., Beil.-Bd. III, Heft 2, 1884, s. 414.

[c] Beiträge z. Kenntniss der Gabbros, Amphibolite, und Serpentine des niederschlesienen Gebirges, Greifswald, 1884, s. 40.

hundred fine sections examined. According to their exterior appearance we may divide the rocks of the quarry into three classes—those of white to light-yellow color, those of light green to dark green, and a third class representing a mixture of the white and colored substances. The first class is not banded or lined; the second is narrow lined, and the third wide lined.

The quarry represents a curve with an opening to the east, and is divided into five different portions of production:

1. The northeastern wall of the quarry.
2. The portion surrounding the large nephrite block discovered in 1899.
3. The portion surrounding the mass of so-called Weiss-stein mentioned by Traube (Ueber den Nephrite von Jordansmühl, p. 414).
4. The portion located in the southern section of the quarry.
5. The portion situated in the eastern section of the quarry.

There is an elevated weather-beaten column in the northern part of the quarry, and another standing to the northwest beyond the quarry proper.

According to the proposed division of the rocks of the quarry into three classes, the selected samples being designated by letters, there are:

1. The samples f, m, n, o, x (stones or rocks white in color).
2. The samples a, b, c, d, e, g, h, k, l, p, r, s, t, u, v, z (light green to dark green).
3. The samples i, q, w, y (combination of white and colored).

Nos. 2 and 3 are from the west wall of the quarry.

In respect to the second class, which is not so important in this examination, the contents are mostly serpentine; next hornblende partially altered, with some nephrite; and, last and of least importance, rocks in which talc and chlorite prevail.

The samples a, b, c, k, r, v, examined under the microscope, present only serpentine. No net-like, reticulated structure is visible, so that olivine as a source is out of the question (as Traube states, Nephrite from Jordansmühl, p. 418). The so-called knitted structure, pointing to the occurrence of pyroxene, is plainly observed. The angle of 90° is generally prevalent. The three first-mentioned samples, coming from the northeastern wall of the quarry, are of columnar structure, but the remainder have a tendency to a small fibrous structure. The presence of minute metallic particles throughout in parallel order points to the development from original pyroxene minerals. Sample t (from the southern portion of the quarry) contains especially numerous residues of the original material, giving the section the familiar porphyritic appearance.

NEW ZEALAND.

The location of a vein of jade, "greenstone," at Milford Sound, New Zealand, has resulted in the organization of a mining company under the name of the Milford Sound Green Stone Company, which has been capitalized with 10,000 shares, at 1 pound sterling each. Until very recently the jade, or greenstone, as it was known, was found only in rolled pebbles or bowlders, varying in size from small pieces to masses weighing as much as the great mass in the British Museum, 1,131 pounds. As this material has been extensively shipped not only to Great Britain and Germany, but to Russia and to China, where many of the finest pieces of art work of recent manufacture are made, it is possible that there will be some market for the output.

THE HEBER R. BISHOP COLLECTION OF JADE AND HARD-STONE OBJECTS.[a]

One of the greatest donations of precious-stone materials to any American institution was that of the Heber R. Bishop collection of jades to the Metropolitan Museum of Art in New York City. This collection is now permanently installed in the new wing of the museum, and occupies the room immediately north of the hall devoted to the J. Pierpont Morgan collection of oriental porcelain. The installation of the jade collection is as stately as that of any in the world, all of the cases, the handiwork of Allard Frères, of Paris, France, being made of gilt bronze and plate glass, designed and executed in the most perfect Louis XV style. The entire hall in fact has been pronounced by a number of foreign architects the finest example of Louis XV style existing anywhere except possibly at Versailles or Potsdam. It is a royal collection, and in cases and surroundings is not surpassed in any European museum. Each article is recorded and described in the great forthcoming catalogue.[a] Considered as a whole, for scientific as well as artistic value, the collection is without a peer in oriental collections of hard-stone objects.

The collection has been arranged and catalogued under the three main headings:

I. Mineralogical, or crude fragments; bowlders, pebbles, etc.

II. Archæological, consisting of implements, weapons, partly worked pieces, and such ornamental and ceremonial objects as were used by the ancient or prehistoric peoples of the countries from which they come.

III. Art objects, embracing the many specimens so artistically designed by the lapidary craftsmen, which are principally from China and India and which form the bulk of the collection.

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[a] Metropolitan Museum of Art Hand-Book No. 10, 1904.

Under this last section there has been made a collection of rock crystal, agate, and other hard stones, beautifully carved and showing a degree of artistic ability equal in all respects to that exhibited in jade carvings, with such change of design as the various textures of the rock crystal, amethyst, agate, jasper, and other materials required.

MINERALOGICAL.

The mineralogical series includes not only fragments of crude jade from mines and quarries and bowlders and pebbles from the beds of jade-producing rivers, but also pieces removed from objects of worked jade for the purpose of chemical analysis or of other scientific research. Every continent except Africa is represented in the various localities, though the list of countries is to a certain extent tentative.

Europe is remarkably well represented by specimens from several localities.

134. A huge block, weighing 2,140 kilos, discovered in 1899 by Mr. George F. Kunz in a stone quarry near the village of Jordansmühl, Silesia, Germany. Several specimens have been detached from different parts of the block and subjected to various tests. Nos. 134 A and 134 B of the collection are from one end, and show much alteration, but No. 134 C from the other end of the block shows the beautiful quality of the almost pure nephrite. These are supplemented by Nos. 135–143, fragments picked up at different times in the same quarry at Jordansmühl——

probably originally part of the large rock and collected at a later date, November, 1900, by George H. Kunz, son of George F. Kunz, and with them is a series of the rocks and minerals associated with nephrite.

ARCHÆOLOGICAL.

It has been customary to designate as celts all objects included in this class; but a study of the collection shows so many different forms classed under this name that they have been separated into axes, adzes, hatchets, knives, chisels, etc., arranged under the names of the countries from which they come. Those from Switzerland, France, China, Mexico, and Guatemala date from the neolithic period and are classed as prehistoric. Undoubtedly from the same period are the greater number of the crude, the rough, and the polished materials from British Columbia, Alaska, and New Zealand, though many of these are quite modern, almost of the present period. In some instances jade has been used in these countries from an unknown antiquity nearly to modern times.

The two specimens classified under this head of partly worked pieces are of special interest because of the evidence they afford of the old methods of working jade.

298. An ancient worked fragment from Guatemala. Exceedingly interesting as showing that in pre-Columbian times crude jadeite existed in Guatemala or Mexico, that it was worked on the spot, and that the aborigines of these regions knew the use of the cylindrical drill.

299. A large partly worked piece from New Zealand. Evidently a stock piece, showing several ground facets and saw marks, and an arrested attempt to remove a long kern or eardrop.

The prehistoric specimens in the collection that served a purpose as ornamental and ceremonial objects are few in number and are all from Mexico and Guatemala, except one piece from New Zealand. They consist principally of beads and pendants of various kinds; some are sculptured, and all are highly polished. Though most of the objects are said to have come from Mexico and Guatemala they are undoubtedly of Mayan origin.

Tomb jades.—A certain number of pieces have been separated from the general collection of art objects of China and grouped under the head of tomb jades. This is a very strong series and exhibits evidences of decomposition of material and staining of surface such as would be produced by burning or by burial underground for a long period. "Han yü" was the name the Chinese applied to the jade which was used in ancient times to be put into the mouth of a corpse before burial, but the name has gradually been extended to include all kinds of jade found in the present day in ancient tombs. The group of tomb jades in the collection contains examples of many curious insignia of rank, many amulets, sacrificial utensils, etc., and ranges in time from the prehistoric period down to the Sung, the Yuen, and the early Ming dynasties. Most of the pieces are to be attributed to the Han dynasty, which flourished from B. C. 206 to A. D. 220. The Chinese themselves cultivate the greatest reverence for antiquity, and they classify pieces of ancient jade as the rarest and most precious of their archaic treasures. No collection of Chinese jade could be considered complete if it did not contain a certain proportion of these ancient specimens.

ART OBJECTS.

The remainder of the collection is comprised under this heading and embraces many specimens of several varieties of jade which have been artistically designed for ceremonial worship in temples or private shrines, for use in the studio of the artist or calligraphist, for the decoration of the cultured home of the Far Eastern virtuoso, in short, for any of the manifold purposes for which this precious material has been utilized by the lapidary craftsman. The artist has occasionally lavished upon it the utmost resources of the glyptic art. The most intricate and delicate lapidary work combined with the greatest detail and perfection of polish and finish have been employed, and, as in India, sometimes the soft sheen of a perfectly rounded box reflecting and multiplying the rich effect of a jeweled decoration has been brought into use.

The Chinese specimens include all art objects of jade from that country, except the few carved pieces which have been separated from the rest and put among the tomb jades. They have been divided into three classes—carved jades, jeweled jades, and jade flowers and fruits; and they have been further classified as far as possible in chronological order, beginning with the Han dynasty (B. C. 206 to A. D. 220) and extending down to the present time. Objects in jade of Chinese manufacture are rarely inscribed with a date outside the imperial workshops in the palace at Peking, so that the inscription of a "mark" under the foot of a piece may generally be taken to indicate that it was especially made for the use of the Emperor whose reign is indicated. There are many such in this collection, and some of the finest pieces came originally from the Yuan Ming Yuan, the summer palace of the emperors of China, situated near Peking, which was burned and sacked during the Anglo-French expedition of 1860.

SPODUMENE, HIDDENITE, AND KUNZITE.

NORTH CAROLINA AND CALIFORNIA.

Spodumene has long been known to mineralogists, but only within recent years has it been ranked among gem minerals. It is a silicate of alumina and lithia, rather complex in constitution and peculiarly liable to alteration, the first effect of which is to destroy its transparency, so that most of the spodumene found is opaque and of little or no beauty. In this condition it is somewhat abundant at several localities in New England and also in Pennington County, S. Dak., the crystals often being very large, but dull and unattractive. It began to be recognized, however, some twenty-five years ago, that all these crystals had undergone alteration and must originally have been very beautiful. The change had proceeded from without inward, and at the center were found portions that still retained the color and transparency that once belonged to the whole. Even these remnants, however, were so fissured and marred that they could hardly be used for gems; but they indicated a lost elegance that led the writer to apply to spodumene the expression "a defunct gem." Since then, however, it has been found in the unaltered state and in several colors at two or three localities, and has come into recognition as an interesting and beautiful gem stone.

The name spodumene is from the Greek *spodos*, ashes, from the dull whitish color of most of the altered crystals. In Europe the mineral is also frequently called triphane. A transparent yellow variety is known from Minas Geraes, Brazil, and these specimens have been to some extent cut into gems. In 1881, Mr. W. E. Hidden discovered numerous clear, bright green crystals at Stonypoint, Alexander County, N. C., which were found in seeking for emeralds. Their real character was not recognized at first, and they were supposed to be cyanite or diopside; but an analysis by Dr. J. Lawrence Smith, of Louisville, Ky., showed them to be spodumene. He proposed for this new variety the name of hiddenite, which it has since borne, and it has also been called lithia emerald. This discovery excited much interest, and the new and beautiful American gem at once came into favor. The yield, however, was limited in amount, and for several years past, because of litigation and from other causes, the mine has not been worked.

Within the last two years another, and by far the most remarkable discovery of gem spodumene, has been made in San Diego County, Cal. The crystals from North Carolina are small, though very beautiful; but the California crystals are of noble size. They are of a delicate rosy lilac or amethystine tint, are perfectly clear and of great brilliancy, so that large and elegant gems can be cut from them. This variety has received the name of kunzite, proposed by Prof. Charles Baskerville, in consequence of its first having been identified by the writer. The amethystine spodumene has also some very marked and peculiar physical properties, to be described further on, which render it a mineral of special interest, apart from its value as a gem stone.

Spodumene occurs abroad in the Tyrol, in Sweden, at Killiney Bay, Ireland, and near Peterhead, Scotland. In the United States it has long been known at Peru and Windham, Me., and at Winchester, N. H., but chiefly at several places in Massachusetts and Connecticut. In the former it appears at six localities in the western part of Hampshire County, in the towns of Chesterfield, Goshen, Chester, and Huntington. These localities and the great crystals there found, with their alteration products and associations, were described and discussed at length in 1878 and 1879 by Dr. Alexis A. Julien.[a] In Connecticut the principal occurrences are at Brookfield and especially at Branchville, and the remarkable development of spodumene at the latter place was similarly described in four articles, from 1878 to 1880, by the late Prof. George J. Brush and Prof. E. S. Dana.[b] It was here that the large altered crystals were found to have retained some interior remnants of their original transparent character, of a rich lilac tint. Some specimens from one or two of the Massachusetts localities also showed remnants of an original green color, translucent to transparent. These extended discussions and the evidence which they presented as to the changed and "defunct" character of spodumene awakened much interest in the mineral and a strong desire to find it somewhere in its original and so largely lost beauty.

Within a year this desire was gratified in part by the finding of the "spodumene emeralds" in North Carolina, already mentioned. The description and analysis were published in 1881 by Dr. J. Lawrence

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[a] Julien, Alexis A., Spodumene and its alterations, from the granite veins of Hampshire County, Mass.: Ann. New York Acad. Sci., vol. 1, No. 10, November, 1879, pp. 318-354.

[b] Brush, George J., and Dana, Edward S., Spodumene and the results of its alteration, Branchville, Conn.: Am. Jour. Sci., 3d ser., vol. 16, 1878, pp. 33, 114; vol. 18, 1879, p. 45; vol. 20, 1880, p. 257.

Smith, who proposed to name the variety after its discoverer, Mr. Hidden.[a] Later in the same year Prof. Edward S. Dana described the variety more fully, especially with regard to crystallography, from additional and finer material.[b]

The circumstances connected with the discovery of this emerald spodumene were related by Mr. Hidden in a paper published in October, 1887. The locality, since known as the Emerald and Hiddenite Mine, is in Alexander County, 16 miles northwest of Statesville, N. C., and about twice that distance southeast from the Blue Ridge.

The finding of the new variety of transparent lilac spodumene in California is one of the most notable discoveries of a gem mineral that has been made in a long time. It not only adds a novel and elegant stone of purely American production to those used in jewelry, but a stone that has great scientific interest from the remarkable properties it possesses in connection with the action of Roentgen (or X) rays and those of radium and like substances. The first of these large and elegant crystals were obtained early in 1903, close to a deposit of colored tourmaline, itself of notable interest, a mile and half northeast of Pala, in San Diego County, Cal., and now known as the Pala Chief. This new discovery is but a half mile northeast of the celebrated rubellite and lepidolite mine at Pala,[c] where recent developments have brought to light great quantities of amblygonite, this species occurring by the ton, while the lepidolite is estimated by the thousand tons. The locality is thus unequaled in the world for its abundance of lithia minerals. The colored tourmalines at the new opening are of remarkable size and elegance; but the spodumene crystals were an unexpected novelty—large, transparent, and beautiful in their color tones, varying from deep rosy lilac at some depth to pale or almost colorless nearer the surface, a change doubtless due to weathering or to the action of sunlight.

The following figures give the weights and dimensions of seven of the principal crystals.

Weight and dimensions of California spodumene crystals.

	Weight.	Weight.	Dimensions.
	Grams.	*Ounces troy.*	*Centimeters.*
No. 1	528.7	17.10	17 by 11.0 by 1.00
No. 2	528.7	17.10	22 by 8.0 by 1.50
No. 3	297.0	9.55	19 by 5.5 by 1.50
No. 4	256.6	8.25	23 by 4.0 by 2.00
No. 5	340.5	10.95	13 by 6.0 by 2.52
No. 6	239.5	7.70	18 by 4.0 by 2.00
No. 7	1,000.0	31.00	18 by 8.0 by 3.00

[a] Am. Jour. Sci., 3d ser., vol. 21, February, 1889, p. 128.

[b] Am. Jour. Sci., 3d ser., vol. 22, September, 1889, p. 179.

[c] Kunz, G. F., Mineral Resources U. S. for 1893, U. S. Geol. Survey, 1894, p. 695; ibid. for 1900, p. 761; ibid. for 1901, p. 748.

These crystals are extraordinary objects to the eye of the mineralogist; to see flat spodumenes of characteristic form as large as a man's hand, but with bright luster and perfect transparency and of this rich delicate pink-lilac tint is a novel and unlooked for experience.

These elegant tourmalines and spodumenes occur near the top of a ridge lying from a mile to a mile and a half from the lepidolite ledge of the old Pala locality, and separted from it by a valley some 900 feet deep. The ledge in which these new minerals occur is on the west side of this ridge and has been traced for 1,200 feet in a northwest-southeast direction. The description given of it suggests a large dike. The rock is a coarse decomposed granite (pegmatite), the feldspar much kaolinized and reduced to a red dirt, and with many large quartz crystals, some of them reaching 150 pounds in weight, but not clear. This remarkable occurrence was first announced by the writer, in Science for August 28, 1903,[a] and in the American Journal of Science for September, 1903,[b] and was further discussed by Dr. Charles Baskerville, in Science for September 4, 1903.[c]

The locality was visited in the summer of the same year by Mr. Waldemar T. Schaller, then of the department of geology of the University of California, now of the United States Geological Survey, and a remarkable account of it was published by him in September. He described the occurence as follows:[d]

> The formation in which these fine crystals are found at the Pala locality consists of a pegmatite dike, dipping westerly at a low angle, perhaps 20 degrees. It is more or less broken, and as a whole seems to form the surface of much of the slope of the hill on which it occurs. The dike is rather broad, but irregular * * * and has a thickness of not more than 30 feet.

Mr. Schaller goes on to say that the remarkable presence of lithia minerals is not found throughout the dike, but is apparently confined to certain rather small portions. This is a curious fact in lithology, and not readily explicable. The rock is mainly a coarse granitic aggregate of quartz and orthoclase, with some muscovite and rather broken and rounded crystals of black tourmaline. At times, however, lepidolite comes in, replacing the muscovite, and with it appear the colored tourmalines instead of the black; and associated with these are the spodumenes. The tourmalines and the lepidolite are frequently inclosed in the quartz and feldspar (as notably also at the Mesa Grande tourmaline locality, and at Haddam Neck, Conn.), but the spodumenes are rarely so found. They usually occur free, in pockets, like the hiddenite spodumene of North Carolina; and from this fact Mr. Schaller at that time regarded them as of later formation.

[a] Science, new ser., vol. 18, No. 452, 1903, p. 280.
[b] Am. Jour. Sci., 4th ser., vol. 16, 1903, pp. 264-267.
[c] Science, new ser., vol. 18, 1903, pp. 303-304.
[d] Schaller, Waldemar T., Spodumene from San Diego County, Cal.: Bull. Dept. Geol. Univ. California, vol. 3, September, 1903, pp. 265-275.

But subsequent discoveries have shown that the occurrence of the spodumenes is probably similar to that of the tourmalines, several specimens having been found in which the spodumene is inclosed in the pegmatite.

The great lepidolite mine at Pala, famous for its radiations of rubellite, occurs in a similar dike of pegmatite, as described by Mr. Schaller, having the same general dip and strike but not containing any spodumenes. The suggestion arises, however, whether the latter may not be represented by the alumina-lithia phosphate, amblygonite, there so abundant. At both points the rock traversed by the dikes is a dark hornblende-diorite containing some orthoclase.

The greater part of Mr. Schaller's paper is occupied with a detailed description of the crystals of spodumene, their physical and optical properties, their crystallization, and their remarkable etching figures, together with an analysis, given on a following page. He mentions also the interesting fact of the occurrence of the green variety, hiddenite, at the same locality, though apparently in small quantity. He speaks of receiving such a crystal, twinned and etched, measuring 26 by 8 by 7 mm., a very fair size for this variety, but does not allude to its transparency or its color as related to gem quality. The report is illustrated with three plates—one showing the locality, one the crystal forms, and a third the etching figures magnified.

Besides this main locality, others have also been discovered in the same general region. One of these, to be presently referred to, is about 25 miles from Pala. Mr. Schaller says that it is "somewhere in the San Jacinto Mountains, probably not far from Coahuila, Riverside County." He adds that kunzite will very possibly be found at other points in the San Jacinto Mountains, and also in the Smith Mountains of San Diego County.

The Riverside County locality is situated on Coahuila Mountain, some 10 miles west of Thomas Mountain, and 20 miles northeast of Pala. It was discovered in May, 1903, by Mr. Bert Simmons. The mine bore his name for some time, but has been sold to a Mr. Fano, of San Diego, and is now known as the Fano mine. Spodumene, green beryl, and gem tourmaline are reported from this mine.

The first specimens of this mineral reached the writer in December, 1902, through Messrs. Tiffany & Co., from Mr. Frederick M. Sickler, who thought them tourmalines. Their exact locality was not given. In August, 1903, he announced that they came from the White Queen mine, near Pala. The crystals, though much smaller in size, are similar to those obtained soon afterwards from the Pala Chief.

The crystals obtained were quite numerous, and vary from half an inch or less to 2 inches in length by an inch in breadth. Some are elegant specimens and could be cut into pale gems. The hardness is about 7.5. They are perfectly transparent and remarkably free from flaws, and they possess the spodumene pleochroism very markedly. Looked at transversely, they are nearly colorless, or faintly pink; but longitudinally they present a rich pale lavender color, almost amethystine. The characteristic etching is also well developed, especially on the pyramidal faces; but all of the crystals are dull upon the surface and are etched all over as if with a solvent.

Three of the largest crystals gave the following measurements:

Measurements of spodumene crystals.

a	53 mm. ($2\frac{1}{8}$ in.) and 35 mm. ($1\frac{3}{8}$ in.)
b	37 mm. ($1\frac{1}{2}$ in.) and 27 mm. ($1\frac{1}{16}$ in.)
c	11 mm. ($\frac{7}{16}$ in.) and 15 mm. ($\frac{11}{16}$ in.)

The specific gravity determined on three crystals was found to be 3.183.

Color, weight, and specific gravity of spodumene crystals.

Color.	Weight.	Specific gravity.
	Grams.	
1. Lavender	20.398	3.179
2. Yellow-white	8.359	3.185
3. Lavender	10.572	3.187

The crystals are so etched and corroded that the terminations are entirely gone, and therefore it is not possible to study their crystallography to much profit. The rounded protuberances and crystallographic points left by the etching are interesting, but it would be exceedingly difficult to make much out of them or to illustrate them. Prof. S. L. Penfield kindly measured the prismatic angle on two crystals and reported as follows: "The prism faces were well developed and gave good reflections. The prismatic angle $m \wedge m'$, $110 \wedge 1\bar{1}0$, on two crystals was found to be 86° 45′, from which $m \wedge m'''$, $110 \wedge \bar{1}10$= 93° 15′.

"For comparison, measurements were made of the cleavage angle of spodumene from Branchville,[a] $m \wedge m'''$=93° 13′; also of the prismatic faces of hiddenite from North Carolina,[b] $m \wedge m$=93° 14′. The angle $m \wedge m$ given by Dana in his System of Mineralogy is 93° 0′, and is based on measurements made with a contact goniometer by Prof. J. D. Dana on a crystal from Norwich, Mass."

Aside from differences in color, the fragments of the California mineral are remarkably like the etched crystals of hiddenite from North Carolina.

This occurrence recalls strongly the famous one at Branchville, Conn., before referred to and described by Brush and Dana, but there the gigantic crystals were almost entirely altered to an opaque mineral.

[a] Brush and Dana, Am. Jour. Sci., 3d series, vol. 20, 1880, p. 257.
[b] Dana, E. S., Am. Jour. Sci., 3d series, vol. 21, 1881, p. 179.

Although these White Queen crystals were the first specimens of the mineral to be clearly recognized and determined, it is the Pala Chief locality that has yielded all the large and elegant crystals that have been cut for gems or made the basis of physical experiments. These have all been received from Mr. Frank A. Salmons, from his mine already described; although the mineral has been found at some other neighboring localities.

It seems now, indeed, that the unaltered pink and lilac spodumene really occurs at several places within a limited region in San Diego and Riverside counties. Mr. Frederick M. Sickler, an explorer very familiar with the district, claims to have been the original discoverer of the mineral some years ago, jointly with his father, Mr. M. M. Sickler, but its composition was not known, and from its association with colored tourmaline it was regarded as a peculiar variety of that species. Since becoming acquainted with its real character Mr. Sickler has searched for it at various points in the vicinity, and has located several claims, together with other parties, particularly a French prospector, named Bernardo Hiriart, and his partner, Pedro Teiletch. The name of Hiriart Mountain has been given to a ridge containing several outcrops yielding these minerals, and Mr. Sickler has furnished the writer with a very clear and connected account of these interesting localities.

He describes the several occurrences as found in three parallel north-and-south ridges called, respectively, Pala Mountain, Pala Chief Mountain, and Hiriart Mountain, lying within a breadth of little over 1 mile and separated by two narrow valleys, each with a stream. On the first named is situated the great lepidolite mine, containing radiated pink opaque rubellite; on the second is the Pala Chief gem mine, where the large crystals of colored tourmaline and kunzite are found; on Hiriart Mountain are several points of kunzite occurrence, including the White Queen mine. The three ridges are much alike geologically, consisting of the same dark bluish-gray diorite described by Mr. Schaller, and traversed by pegmatite dikes, with a north-and-south strike and a westerly dip. Mr. Schaller states that there is a marked difference between the upper and lower portion of these dikes, the former having the coarse pegmatite character and containing the tourmalines and spodumenes, and the latter being a fine-grained, striped rock consisting chiefly of quartz, feldspar, and mica. If this fact be established as general, it shows that the gem minerals lie within a somewhat limited zone, which may in time be worked out. The fine crystals of the upper portion are found mainly in pockets, with crystallized feldspar and quartz, and often embedded in a peculiar pink or reddish clay-like substance. This latter is doubtless the same as that identified by the writer with montmorillonite, which has been noted at Branchvillé, Conn., Paris, Me., and other localities of lithia minerals.

In the coarse upper portion a great variety of minerals have been developed. Mr. Sickler enumerates the following: Quartz—ordinary, milky, smoky, rose, and amethystine, also hyalite; orthoclase; albite; pyroxene; hornblende, green and black; spodumene—colorless, straw-yellow, lilac, and green; beryl—colorless, green, yellow, and rose; garnet; epidote; tourmaline—black and of many colors; micas—lepidolite, muscovite, biotite, damourite, and cookeite; montmorillonite; amblygonite; triphylite; and among the metallic oxides, hematite; sulphides, pyrite and molybdenite; bismuth, native and the oxide; also apatite, siderite, and columbite.

On the Hiriart Mountain there seem to be numerous dikes instead of one or two great ones, as on the other two ridges. Many outcrops and openings show lepidolite, and several show kunzite at various points on the ends and on both sides of the ridge. Eleven claims are located and more or less developed. These are the following:

San Pedro claim, north end; by Bernardo Hiriart and Pedro Teiletch; lepidolite and gem spodumene.

Sempe claim, crest and west slope; by the same; lepidolite, beryl, and colored tourmaline.

Anita claim, west side; Hiriart and his partner; lepidolite.

Catarina claim, south side; Hiriart and M. M. Sickler; lepidolite, amblygonite, and gem spodumene at two openings.

El Molino claim, south side; F. M. and M. M. Sickler; gem tourmalines.

Center Drive claim, south side; by the same; beryl and gem tourmaline.

White Queen claim, south side; F. M. Sickler; lepidolite, beryl, and spodumene. This is the mine where the first kunzite crystals that reached the writer were found in 1902, as above mentioned.

Hiriart claim, south and east side; M. M. and F. M. Sickler; lepidolite and gem tourmalines.

Vanderberg claim, south slope; M. M. Sickler; lepidolite, beryl, gem tourmaline, and gem spodumene.

Naylor claim, east slope; F. M. and M. M. Sickler; lepidolite and gem spodumene.

In addition to these the Sicklers, father and son, own the Fargo claim, on the west slope, which is promising, but hardly developed. They have recently reported the finding of a very fine, deep-colored crystal of kunzite, almost flawless, measuring 12.5 by 8 by 3 centimeters, at one of their newer claims on this mountain, 20 feet in the ledge and 16 feet from the surface.

CHEMICAL COMPOSITION.

Two separate accounts have appeared as to the composition of kunzite spodumene, which are in the main closely accordant. One of these is an analysis by Prof. Charles Baskerville and Mr. R. O. E. Davis, and the other is the average of several analyses by Mr. W. T. Schaller. The results are as follows:

Analyses of kunzite spodumene from Pala, Cal.

Constituent.[a]	Per cent.	Constituent.[b]	Per cent.
SiO_2	64.05	SiO_2	64.42
Al_2O_3	27.30	Al_2O_3	27.32
NiO	.06	Mn_2O_3	.15
MnO	.11	Li_2O	7.20
ZnO	.44	Na_2O	.39
CaO	.80	K_2O	.03
MgO	None.	Fe_2O_3	None.
K_2O	.06	CaO	None.
Na_2O	.30	MgO	None.
Li_2O	6.88	Ign	No loss.
Loss on ignition	.15	Total	99.51
Total	100.15		

[a] Am. Jour. Sci., 4 ser., vol. 18, July, 1904; R. O. E. Davis, analyst.
[b] Bull. Dept. Geol. Univ. California, vol. 3, 1903, p. 274; W. T. Schaller, analyst.

The lime, zinc, and nickel, in the first of these analyses, are unusual and peculiar ingredients. Otherwise, both compare pretty closely with Professor Penfield's results[a] for the unaltered pink spodumene remnants at Branchvile, Conn.

At about the same time that the Pala spodumenes were coming into notice, the writer became engaged in a series of investigations upon the behavior of gem-minerals with ultraviolet light, Roentgen rays, and various forms of radio-activity. These studies were carried on for several months in conjunction with Prof. Charles Baskerville, of the University of North Carolina, and resulted in a number of interesting determinations; but all that calls for reference here is the peculiar action of this new variety of spodumene, which was found to be remarkably sensitive to such agencies. It was in connection with these studies and the facts which they developed that Doctor Baskerville proposed to name the new variety after the writer.[b] The following extract from his paper gives his first statement of these observations:

During an extended investigation on certain optical properties of the Tiffany-Morgan Gem and Bement Mineral collection in the American Museum of Natural History it has been my privilege to examine the new lilac-colored transparent spodumene described by Dr. George F. Kunz in Science, August 28, 1903, page 280, No. 452, vol. 18. It has been my good fortune to see and handle from this locality massive spodumene crystals (10 by 20 by 4 cms.), perfectly clear, of a rose-lilac tint, varying with the spodumene dichroism from a very pale tinge when observed transversely to the prism to a rich amethystine hue longitudinally.[c] No such crystals of spodumene have

[a] Penfield, Am. Jour. Sci., vol. 20, 1880, p. 259.
[b] Baskerville, Charles, Kunzite, a new gem: Science, new series, vol. 18, Sept. 4, 1903, pp. 303-304.
[c] Kunzite is highly dichroitic. With the dichroscope the darker specimens show a rich deep purple for the ordinary ray and a pink for the extraordinary ray. In the lighter crystals, almost like pink topaz in color, the ordinary ray is pink and the extraordinary ray almost white. To the rubbing touch kunzite is not resistant, being in this respect more like topaz.

ever been seen before, and the discovery is of great mineralogical interest. The crystals have been etched by weathering, like the hiddenite variety. The mineral when cut and mounted parallel to the base gives gems of great beauty. The chemical analysis, which is under way in my laboratory, will shortly be published.

The observations of Doctor Kunz sufficiently characterize this mineral of peculiar beauty as a new gem, which he has not named. I have submitted large crystals to the action of ultra-violet light with very positive continued phosphorescence. When subjected to bombardment of the Roentgen rays of high penetration for several minutes no fluorescence is observed, but on removal to a dark chamber it exhibits a persistent white luminosity not observed with this class of minerals, as learned by experiments with altered and unaltered spodumene from the localities mentioned, including cut stones and such handsome crystals of hiddenite as afforded by the collections mentioned. I have been able to excite a crystal (2 by 4 by 10 cms.) by the action of the X-rays for five minutes sufficiently to cause it to photograph itself when subsequently placed directly upon a sensitive plate (thin white paper being interposed) and allowed to remain in an especially constructed padded black box in a dark room for a period of ten minutes. The material is penetrated by the rays as shown by a cathodegraph. The excitation is not superficial, but persists throughout the mass. On account of this unusual and characteristic phosphorescence, as well as of the other properties, I propose the name "Kunzite," for reasons unnecessary to give to American and European scientific men.

The subject thus opened was followed up by Doctor Baskerville and the writer, and the results were presented in a joint paper published in July, 1904.[a] From this the following paragraphs are taken:

In a recent investigation[b] made by us on the behavior of a large number of minerals and gems with various forms of radiant energy, including the emanations, as well as on the production of luminescence in some cases by other physical means, the new variety of spodumene, designated kunzite, was found to be peculiarly sensitive and to exhibit some remarkable properties.

In general, as shown by these investigations, the gem-minerals were little affected by ultra-violet rays; but three species exhibited a high degree of responsiveness to these and to all forms of radio-activity, so far experimented with. These minerals were diamonds of certain kinds; willemite (zinc orthosilicate), which in some cases has been used as a gem-stone, and kunzite. The behavior of the last, as noted in various experiments, is unique and will be briefly described here by itself.

1. Attrition and heat.—Kunzite does not become luminous by attrition or rubbing. Several specimens were held on a revolving buff cloth making 3,000 revolutions per minute, so hot as to be almost unbearable to the hand, and still it failed to become luminous. Wollastonite, willemite and pectolite are, however, very triboluminescent.

As to luminescence induced by heat alone, it was found that kunzite does possess the property of thermo-luminescence to some extent, with an orange tint and at a low degree of heat.

2. Electricity.—The mineral assumes a static charge of electricity, like topaz, when rubbed with a woolen cloth. On exposing kunzite crystals of different sizes to the passage of an oscillating current obtained from large Helmholtz machines, the entire crystal glowed an orange-pink, temporarily losing its lilac color. A well-defined, brilliant line of light appeared through the center, apparently in the path of the current. On discontinuing the current, the crystal gave the appearance of a glowing coal. It was not hot, however, and the phosphoresence lasted for forty-five minutes.

[a] Baskerville, Charles, and Kunz, George F., Kunzite and its unique properties: Am. Jour. Sci., 4th ser., vol. 18, 1904, pp. 25–28.

[b] Science, new ser., vol. 18, 1903, p. 769.

Three large crystals, weighing 200, 300, and 400 grams each, were attached to copper wires so that the current passed from below upward, in one case lengthwise of the prism and in the other across the width of it. In each instance the crystals became distinctly luminous, a pale orange-pink, and between the two wires a bright almost transparent line passed from one wire to the other; in reality, as if two elongated cones crossed each other, the line of the path being transparent at the sides, whereas the rest of the crystals appeared translucent. After the exposure of two minutes they were laid upon photographic plates, and in five minutes produced a fine auto-print. The crystals continued to glow for forty-five minutes.

When a cut gem is suspended between the two poles it becomes an intense orange-pink color, glowing with wonderful brilliancy. The discharge seemed as if it would tear the gem asunder, although actually it was unaffected.

3. Ultra-violet rays.—These invisible rays, produced by sparking a high voltage current between iron terminals, caused kunzite, white, pink, or lilac, to phosphoresce for some minutes. The white responded most readily.

4. Roentgen or X-rays.—All forms of kunzite become strongly phosphorescent under these rays. An exposure of half a minute caused three cut gems to glow first a golden pink and then white for ten minutes. The glow was visible through two thicknesses of white paper which was held over it. A large crystal excited for five minutes afterwards affected a sensitive photographic plate.[a] Another crystal exposed for ten minutes was laid for five minutes on a sensitive plate.[b] The resulting autophotograph was clear and distinct, but presented a very curious aspect not seen by the eye—as of a misty or feathery outflow from the side and termination of the crystal, suggesting an actual picture of the invisible lines of force. The other varieties of spodumene, natural mineral and cut gems, failed to show this property. We are not yet in a position to offer a satisfactory explanation of this fact.

5. Conduct with radium preparations.—Exposed for a few minutes to radium bromide with a radio-active strength of 300,000 (uranium being taken as unity), the mineral becomes wonderfully phosphorescent, the glow continuing persistently after the removal of the source of excitation. The bromide was confined in glass. Six hundred grams of kunzite crystals were thus excited with 127 milligrams of the radium bromide in five minutes. The effect is not produced instantaneously, but is cumulative, and after a few moments' exposure the mineral begins to glow, and its phosphorescence is pronounced after the removal of the radio-active body. The luminosity continued in the dark for some little time after the radium was taken away. No other varieties of spodumene examined, including hiddenite, gave like results. In this respect, as with the Roentgen rays, the kunzite variety stands by itself.

When pulverized kunzite is mixed with radium-barium chloride of 240 activity or with carbonate of lower activity the mixed powder becomes luminous and apparently remains so permanently; i. e., in several months no loss has been observed. The same is the case if pulverized wollastonite or pectolite be used instead of the kunzite. When either of these mixtures is put in a Bologna flask and laid on a heated metal plate (less than red-hot) the powder becomes incandescent and remains so for a long time after removal.

These three minerals phosphoresce by heat alone, as was mentioned above in regard to kunzite. Perhaps this luminosity of the mixed powders at the ordinary temperature may be accounted for in part by the evolution of heat[c] on the part of the radium compounds, but there are experimental reasons which cause us to reject such explanation for the total effect.

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[a] Science, new ser., vol. 18, 1903, p. 303.

[b] This test was made by Dr. H. G. Piffard, of New York city.

[c] P. Curie and Laborde, Comptes Rendus, vol. 136, p. 673

The *emanations* of radium, according to Rutherford,[a] are condensed at a temperature of —130° to —140° C. The emanations were driven from radium chloride by heat and condensed with liquid air on a number of kunzite crystals, according to a method which will be described by one of us (B) and Lockhart in another paper, and *no phosphorescence observed.* Consequently *kunzite responds only to the γ rays.*

6. *Actinium.*—A sample of the still more rare and novel substance discovered by Professor Debierne[b] and received from him through the courtesy of Professor Curie, was also tried as to its action upon kunzite and some other minerals. The actinium oxide, with an activity of 10,000 according to the uranium standard, gave off profuse emanations and affected diamonds, kunzite, and willemite in a manner similar to the radium salts, with quite as much after-continuance. However, we have not tried the condensation of these emanations upon the minerals by refrigeration.

The peculiar properties of the kunzite variety of spodumene which have been enumerated have not been observed in any other of the gems or gem minerals that we have examined. It is barely possible that the small amount of manganese may have much to do with it, but from our present knowledge basing a chemical explanation thereon is idle.

Sir William Crookes, the eminent English physicist, conducted some similar experiments on the behavior of kunzite with radium bromide and obtained identical results, as stated by him in a letter to the writer in October, 1903.

USE OF KUNZITE IN JEWELRY.

Kunzite has now been cut and sold as a gem for about one year, and has been received with much favor as a new and a wholly American gem. At first it was feared that it might be difficult to cut, as many specimens, being mistaken for a variety of tourmaline, were ruined in the attempt to cut them because of their strong tendency to cleavage. But the fact that kunzite spodumene has a facile cleavage in one direction was soon understood by lapidaries who were familiar with the cutting of the hiddenite variety or of the yellow spodumene from Brazil.

The result is that there has been no difficulty in having the gem cut into every form—brilliant, degree top, mixed brilliant, and other styles—and of sizes weighing from one to one hundred and fifty carats each. In color they vary from almost white with a faint pink tone through pink and lilac pink into dark lilac. The gem is remarkably brilliant, no matter what the color. It is usually perfect and free from flaws, and, when pink, is one of the few natural stones of that color. As a lilac gem it is quite unique. The price has varied from six to twenty dollars per carat, although generally it has averaged one-third of the latter figure.

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[a] Philos. Mag., vol. 5, 561.

[b] Comptes Rendus, vol. 129, p. 596.

QUARTZ.

SMOKY QUARTZ.

MARYLAND.

In the report of this Bureau for 1896 reference was made to a large crystal of smoky quartz from Harford County, Md., and to the evidence afforded by the numerous pebbles of this material in the Potomac gravels of its presence in considerable amount in the crystalline rocks farther up. It seems that an enormous specimen of this mineral was obtained in Maryland many years ago, which has not been heretofore recorded. Mr. Edward C. Mitchell, president of the Academy of Sciences of St. Paul, Minn., writes that he has in his possession a fine crystal of smoky quartz, 16 inches long, 7½ inches in diameter, and weighing 47 pounds, which he found in 1860 near Ellicott's mills, in Howard County, Md.

BLUE QUARTZ.

WYOMING.

A discovery has lately been made in Wyoming of a beautiful mineral association, consisting of a brilliant coating of quartz crystals over a blue or greenish-blue copper silicate. The specimens are similar to those so well known and so much admired from the Globe mine, Gila County, Ariz., and are quite equal to them in elegance. The Wyoming locality is the Sunrise mine, near Hartville, Laramie County, a region already known for its remarkable moss agate. In the specimens here obtained the base is a reddish-brown ironstone; upon this rest successively a layer of fibrous radiated green malachite, then of a blue chrysocolla, and then of a pale, almost turquoise, blue mineral (cupreous allophane?), upon which is a coating of quartz crystals, sometimes colorless, translucent to transparent. The sparkling surface and the rich blue-green color showing through it from beneath make a combination of great beauty, and this quartz is generally thick enough to admit of a polish and makes a very pleasing ornamental stone.

AMETHYST.

NEW JERSEY.

Amethysts in beautiful specimens have been found on the Haledon property and in the Sourbut quarry at Paterson Falls, Paterson, N. J. The crystals are generally very dark purple at the points, turning into white at the base, and occur associated with apophyllite and other zeolites in a trap rock, being found in the blasting for that rock, which is extensively used as a road-making material in the vicinity of Paterson and elsewhere in New Jersey.

NORTH CAROLINA.

Amethysts in groups of crystals were found in a mica mine in the valley of Cashiers, North Carolina, by Rev. H. Bennett, about 100 yards from the Adams house. There were two masses weighing from 10 to 20 pounds each, made up of grouped crystals; one was beautifully clear, but flawed, and the other was smoky amethyst.

NONCRYSTALLINE QUARTZ.

AGATE AND CHALCEDONY.

TEXAS.

A magnificent series of agate and chalcedony specimens ranging from 2 to 6 inches in length and 4 inches across, beautifully polished, were shown in the exhibit of the State of Texas at the Louisiana Purchase Exposition, St. Louis, 1904. These agates were collected and prepared under the direction of Prof. William B. Phillips, director of the State mineral survey at Austin, Tex. They were found in many places in the counties of Pecos, Brewster, Presidio, Jeff Davis, and El Paso. The more important localities are in Brewster County, from 10 to 15 miles northeast of Alpine and from 15 to 20 miles south of the same town; also south and southeast of Santiago Peak, and at many points in the lower part of the county; and in Presidio County, from 10 to 15 miles south of Marfa. These are the localities which have produced the best agate so far.

MOSS AGATE.

WYOMING.

Large masses of the moss agate, as mentioned in this report for 1894, have been found in abundance in the foot range of the Black Hills, in the Hartville mining district, about 130 miles north of Cheyenne. The material occurs in lenses, or interrupted veins, from 5 to 6 or more inches in thickness, and varying in width from 2 to 3 feet. More than 7 tons of it were mined during the year 1903, and sent to Germany for cutting.

AGATIZED WOOD.

ARIZONA.

Petrified forests of Arizona.—Prof. Oscar C. S. Carter, in the Franklin Institute Journal,[a] presents an admirable article on the petrified forests of Arizona, giving exact information as to how to visit the locality. The article contains illustrations of the forest and a map

[a] Jour. Franklin Inst., vol. 157, No. 4, 79th year, April, 1904, p. 293.

showing its relation to the Painted Desert. A magnificent series of the agatized wood is now (at the time of the writing of this report) on exhibition in Block 40 of the Mines Building at the Louisiana Purchase Exposition, St. Louis, Mo. It is the finest collection that has ever yet been shown to the public: single stumps weigh 1 ton or more, each stump 5 or 6 feet in length; slabs 5 feet in diameter are magnificently polished by the ingenious mechanical contrivance devised by Colonel Drake and driven by water power at Sioux Falls, S. Dak.

EGYPT.

Silicified wood from Egypt.—Dr. Alexis A. Julien[a] gives a description of a specimen of silicified wood from a petrified forest near Cairo, and the mode of distribution of the fungus throughout its ducts. An interesting association of crystals of hematite and of pseudomorphs after gypsum and halite occur, which testifies to the earlier conditions of petrifaction. The organic forms have been preserved in remarkable perfection and abundance. The generic relationships and genetic local history of the wood are then discussed, with a review of various theories of the process of silicification.

OPAL.

IDAHO.

Considerable interest was manifested in the opal mines of the Lemhi district, Owyhee County, Idaho, described in the report of this Bureau for 1902. Several companies were organized, but little active work was done, and for financial reasons operations were suspended.

WEST AUSTRALIA.

Mr. Edward L. Simpson, mineralogist of West Australia, communicates a discovery of crocidolite opal made three years ago by two prospectors, in all about 2 pounds of this material being obtained at the Bulgaroo opal mine in about latitude 26° S., longitude 116° E. The miners were compelled to abandon the lease on account of lack of water. Mr. Simpson believes the stone to be a replacement of veins of asbestos by hydrous silica and oxides of iron. The opal was fawn colored and the crocidolite a pale reddish brown, the opal and the crocidolite occurring in alternate bands, and when the stone is polished a beautiful effect of the silky reflection of the crocidolite combined with the rich fawn color of the opal is obtained, which causes the stones to differ from any variety of these gems found anywhere else.

[a] Geol. Soc. America, Sixteenth Winter Meeting, St. Louis, Mo., December 30, 1903–January 1, 1904.

MOONSTONE.

CALIFORNIA.

Minute crystals of the adularia variety of moonstone with beautiful blue reflections, occurring in a volcanic rhyolite rock, were found at Rialto, in the Funeral Mountains, in Inyo County, Cal., near the line marking the boundary between California and Nevada. These tiny moonstones are of wonderful beauty, but are valueless on account of their small size. They were supposed to be opals by many collectors who distributed them.

NORTH CAROLINA.

On the Bowman place, 1 mile north of Bakersville, Mitchell County, N. C., has been found an oligoclase, or sagenitic moonstone, containing, in addition to the beautiful luster, interior reflections, which are due to the presence of crystals of goethite, making it really a moonstone with sunstone effects. The occurrence was noted by Mr. Daniel C. Bowman, of Bakersville, N. C.

WEST AUSTRALIA.

Mr. E. L. Simpson, mineralogist of West Australia, says that he has found several fine specimens of moonstones on the old beach at the mouth of the Bows River, 28° 30′ S., 114° 30′ E., in an hour's picking.

FUCHSITE.

Fuchsite as an ancient decorative stone.—Among the various green minerals used by the ancients for decorative purposes, compact fuchsite must now be included. An interesting account is given by Prof. H. A. Miers, of London, of a fragment of a Roman statuette composed of this material.[a] It was found in the Oxford collection, but with no record of its source. The specimen is 3 inches long, and represents the thigh of a human figure from the hip to the knee. It is well executed and is referred by archæologists to the best period of Roman work. The piece is bored at both ends, as though the figure was made of portions fastened together, thus suggesting that the material was scarce and not to be had in large pieces.

The stone is of an emerald-green color, translucent, and beautifully polished; it is not quite uniform in tint, having clouds or patches of deeper green, and also of brown. There are bright internal reflections, resembling flawed emerald; but the fractured surface shows the texture of a compact micaceous mineral, consisting of minute flakes or plates. The microscope reveals for these an axial angle of about 70° and a negative bisectrix nearly perpendicular to the cleavage. The

[a] Mineralog. Mag., vol. 13, No. 62, December, 1903, p. 332.

brown patches, which resemble iron stains, are found to be caused by minute inclusions, probably rutile. Blowpipe examination shows the presence of chromium, thus identifying the material as fuchsite. Its density is 2.84.

The specimen thus determined is a surprise to archæologists, who have never known it or, at least, recognized it before. Max Bauer, indeed, has noted its use as the material of prehistoric beads in Guatemala.[a] But it is new to classical students, and Professor Miers thinks that this discovery may lead to others heretofore unsuspected. The micaceous character would not be observed in a piece entirely polished, and specimens may exist that have never been recognized. The color and luster are so beautiful that Professor Miers thinks it may well have been a valued ornamental stone, and very probably was one of the many kinds of so-called smaragdus. He quotes Pliny's description of one variety as being quite suggestive of this compact emerald fuchsite.[b]

TURQUOISE.

NEW MEXICO.

An extended account of the turquoise of the Cerrillos hills in New Mexico, by Mr. Douglas W. Johnson, now of the Massachusetts Institute of Technology, has been published within the last year in the School of Mines Quarterly of Columbia University,[c] New York City. The discussion occupies three papers—one on the general geology of the turquoise and two on the petrography, the last of which deals more particularly with the matrix rock. The articles are illustrated with plates, and accompanied by analyses, historical notes, and comparisons of material from other places.

The exact localities are clearly defined. The great ancient excavations that attracted so much attention at first are on what is called Mount Chalchihuitl, an inconspicuous hill or knob east of Grand Central Mountain, which latter is the most prominent point in the line of the Cerrillos hills. These two have been confounded by some observers. The old workings, after being reopened and to some extent developed, were ere long abandoned for what was found to be a more favorable locality, where are now the main workings of the American Turquoise Company. These are "situated at the southeastern end of Turquoise hill, a low ridge rising above the level of the plains northeast of the main group of hills." On this ridge also are very ancient mines at several points, but they have not attracted so much notice as the extraordinary excavations at Mount Chalchihuitl, where work was done with the aid merely of stone hammers and fire that is actually amazing

[a] Centralblatt für Mineralogie, 1900, p. 291.
[b] Hist. Nat., lib. XXXVIII, 18.
[c] School of Mines Quart., July–October, 1903.

in its extent. "The whole north side of the hill has been quarried out, * * * while less extensive excavations are found in other parts of the so-called mountain." The mass of rock taken out forms a ridge surrounding the great opening, and appears in the photograph as a sloping hill overgrown with cedars and piñons; beyond this rises the cliff-like wall of the main excavation, which goes down to a great depth. Prof. William P. Blake, the first describer, in 1858,[a] referred to the débris as thousands of tons in quantity; and Prof. Benjamin Silliman, in 1880,[b] estimated it, on the authority of a local surveyor, as covering 20 acres of ground. Both these observers noted the size and age of the trees growing on the dumps and down in the main pit as proofs of great antiquity, and Mr. Johnson corroborates their testimony. All the indications point to the cessation of this long-continued exploitation by the native peoples from the time of the great fall of rock in 1680 that cost many lives, and is believed to have led to the uprising in the same year against the Spaniards and their expulsion from the region. Of this rock-fall Mr. Johnson says: "I was able to get far enough back through the débris of the slip to make out a part of the old roof of the cave formed by the overhanging cliff. It was still black from smoke of ancient fires, and served to give a very good idea of the extent of the great disaster."

A careful discussion follows of the geological relations of the turquoise at these localities, and of the views of previous writers as to its origin. The rock is a white or sometimes yellowish material that has been taken sometimes by unskilled observers for a sandstone, but which geologists have constantly recognized as an altered eruptive rock. The earlier describers called it a trachyte, but it is now shown to be undoubtedly an andesite. Mr. Johnson goes largely into the discussion of the evidence on this point in the second part of his paper. He calls the matrix of the turquoise "an altered phase of the augite andesite forming the main portion of the Cerrillos hills." The turquoise itself "occurs as seams throughout the rock, filling crevices formed by crushing and shearing, and as little nodules in streaks or patches of kaolin." The microscopic structure of these two forms and their relations are treated of in his third article.

As to the origin of the turquoise there have been three theories advanced. The first was that of Prof. Benjamin Silliman, in 1881,[b] who regarded the mineral as resulting from alteration of the rock of the region by the rise of heated vapors through the lines of fracture and shearing. Thus was produced a breaking down of the crystalline structure in the "trachyte" of the Cerrillos, with more or less kaolinization. The alumina of the turquoise was derived from the

[a] Am. Jour. Sci., 2d ser., vol. 25, pp. 227-232.
[b] Ibid., 3d ser., vol. 22, 1881, pp. 67-71.

feldspar thus decomposed, and the phosphoric acid from apatite, which is a good deal disseminated through the feldspathic rock when less altered. The small percentage of copper came up with the heated vapors. The turquoise was thus regarded as a primary product of alteration in the matrix rock.

The second theory was that proposed by Prof. F. W. Clarke and Mr. J. S. Diller, in 1887.[a] It held to a somewhat similar origin, only the turquoise was regarded as a secondary alteration product, derived from veins and nodules of apatite.

The third view, announced by Dr. C. L. Herrick in 1900,[b] considered the turquoise to be due to contact metamorphism, by the outbreak of syenitic intrusions through mesozoic strata. "It would appear * * * that the turquoise owes its origin to action of the molten syenite on the copper-bearing sandstones of the Jurassic * * * caught up in its escape." This hypothesis was referred to in the report of this Bureau for 1900, and the views of Doctor Herrick stated somewhat fully, with a suggestion that further investigation was needed to establish them.

Between these different theories Mr. Johnson finds little difficulty in deciding. The last is dismissed as without substantial basis. No sandstones are known in the vicinity, all the rock of the Cerrillos being igneous. The question therefore lies entirely between the theories of Silliman and of Clarke and Diller. The turquoise is in the one view a direct and contemporaneous product of alteration of the feldspathic rocks, and in the other a secondary and subsequent one, replacing apatite. Mr. Johnson feels confident from extended study of the locality and of microscopic sections that the former is the correct theory. He notes the entire absence in the turquoise veins of either any remnants of apatite or any traces of the crystalline structure usually so marked in that mineral. All his observations lead him to regard the turquoise as having formed directly and not by secondary alteration. The general process is considered as well outlined by Silliman: the alumina as derived from the partial decomposition of the andesite by heated waters or vapors rising through the zones of fracture and shearing, the phosphoric acid as coming from apatite disseminated through the andesite as a previous accessory constituent, and the copper as brought up with the altering vapors. In regard to these last two points the fact is noted that apatite is "usually abundant in all the fresher portions of the rock, sometimes occurring as quite large crystals" (though generally minute), but "is seldom seen in the more decomposed portions containing the turquoise—which is just what we should expect on * * * the theory * * * —here supported." As to the copper, its introduction by the altering solu-

[a] Bull. U. S. Geol. Survey No. 42, 1887, pp. 39–44.
[b] Rept. Governor of New Mexico, 1900, p. 258.

tions is connected with the cupriferous solutions which gave rise to the copper ores of the general region. "In the mines of the American Turquoise Company the copper is found forming a green coating (of malachite) on the walls of the tunnels, etc., whenever the rock is left undisturbed for any length of time."

The presence of minute amounts of fluorite is noted as highly suggestive. It is associated with the turquoise in many instances and bears about the same ratio to the phosphoric acid of the latter that the fluorine does to the acid in ordinary apatite. This fact is a strong indication of an apatite origin for the turquoise, although it does not clearly determine anything as between the two theories propounded.

The second part of the article, on petrography, is divided into two portions—one dealing with details of the occurrence and structure of the turquoise itself and its most immediate associations and the other with the matrix rock. The turquoise, in seams and veins and in small nodules, varies from the finest shade of blue to a full green. Many specimens are marred by specks or veinlets of kaolin or of limonite, the latter derived from pyrite, which sometimes remains unaltered as brilliant little crystals embedded in the turquoise. Though opaque in the mass, the mineral is almost clear and colorless in thin sections. Two types of structure are well marked—one fibrous transversely to the vein or seam and the other fibrospherulitic. The former of these was emphasized by Clarke and Diller, whose accounts are largely cited; the latter was conspicuous in many sections examined by Mr. Johnson. Considerable space is given to details of microscopic and optical examination of these varieties. The presence of an isotropic mineral, apparently fluorite, is described, sometimes as a very thin layer between the turquoise of a veinlet and the wall of altered andesite, and at other times as an interstitial filling between the spherulites when these are pronounced. "The appearance of the turquoise as seen in the above relations strongly suggests the crystallizing out of the gem from solutions in small fissures, excluding the molecules which later formed the fluorite (?). If these solutions * * * represented in part the original apatite scattered through the country rock, the occurrence of the fluorite would be quite natural. The evidence does not * * * suggest to me the formation of the turquoise from * * * vein apatite formerly occupying these same fissures." Moreover, he adds, "no evidence of vein apatite has ever been found in the region," while it is a striking fact that the finely distributed apatite content of the unaltered andesite has in some way disappeared from the altered portions where the turquoise occurs. On all these grounds Mr. Johnson holds decidedly to "the simpler method of origin—that the gem is a secondary product, but the original occupant of the vein." The remainder of this part of the paper is given to analyses of turquoise from these and various other localities, with notes on their special physical peculiarities.

The portion of the paper that treats of the petrography of the matrix rock is mainly occupied with a discussion as to the nature of the largely altered feldspar of which it consists. Messrs. Clarke and Diller pronounced this to be chiefly orthoclase with a small amount of plagioclase, which they regarded as secondary; these conclusions rested on microscopic evidence and on one or two analyses that showed considerable potash; and these writers remark that this result is rather unusual among the igneous rocks of the Southwest. Mr. Johnson takes issue with these determinations, and holds that they must be based upon exceptional material, as in his study of many sections he found the crystalline structure to be chiefly that of a plagioclase, which is not secondary, but the main ingredient of the rock. The pieces examined were taken partly from the actual excavations on Mount Chalchihuitl and partly from less altered rock in the adjacent country; and on this and other evidence Mr. Johnson bases his strong conviction that the matrix of the turquoise is simply an altered phase of the augite-andesite of the region.

MEXICO.

Turquoise, which is known at so many points in Arizona, New Mexico, and southern California and Nevada, must undoubtedly occur in the similar rocks south of the United States boundary line, but has not been heretofore observed there to any considerable extent. The discovery of a turquoise mine, however, is now announced in Mexico, in the State of Zacatecas. The locality is in the Santa Rosa district, near the town of Bonanza, at a mine which was worked for silver (argentiferous galena), and the discovery was accidental. According to the manager, Mr. V. D. Williamson, it was made by a lady, Mrs. V. M. Clement, a stockholder in the company operating the mine, who lived for a time at Bonanza, and frequently visited the workings and picked up minerals, etc. About a year ago Mrs. Clement gathered some small pieces from the dumps that she thought resembled turquoise, and, though others made light of it, she insisted on their being sent to the city of Mexico and analyzed. They proved to be true turquoise, and search was at once made for more. The mineral is found both in veins and in nodules, and is said to be of rich color and of fine quality; and the mine is now operated mainly for the turquoise. No particulars are yet given as to the quantity obtained nor the character of the rock in which it occurs.

AMBER.

EAST PRUSSIA.

A very extended account of the amber production of the Baltic coast was prepared by Dr. R. Klebs to illustrate the great amber exhibit at the Louisiana Purchase Exposition, and published as a guide thereto.[a]

After some general remarks on the geology of northern Europe and the great geographical changes that took place in Tertiary time consequent upon the elevation of many of the most important mountain chains, Professor Klebs proceeds to consider the special conditions under which amber was produced. He says:

> Where the Baltic Sea is now situated there was formerly land, the southern limit of which was not very far from the Baltic shore of to-day. This land was the home of amber.

He describes the development here of a luxuriant vegetation, chiefly of resinous trees, growing on the calcareous soil of the chalk formation raised from beneath the sea. A multitude of successive generations of these trees flourished and died, their imperishable resin accumulating in the soil through long periods of time, while the woody portions decayed and have mostly disappeared.

> From their remains it is shown that the vegetable and animal life of that period have a close connection with those existing at the present day in the southwestern parts of North America and in Japan. The character of the amber forest is distinguished by a great number of oaks and conifers, especially of the Thuja group, with which are found Camelliaceæ, Lauraceæ, and numerous other families.

The wood found in direct connection with amber, or inclosed in it, is uniformly seen to be coniferous when its structure is microscopically examined. This evidence, however, is general only, and gives no means of identifying the species. "A specimen of amber containing both the wood and the leaves belonging to it has not yet been found. Awaiting this happy chance, it must remain an open question whether the amber conifers belong to the genus *Pinus* or the genus *Picea*. Hence it is best to give the amber tree Göppert's name of *Pinites succinifer*, which leaves it indefinite whether it is a pine or a fir."

On this point, Professor Klebs differs from the amber specialist, Doctor Conwentz, of Danzig, who holds that the microscopic structure of the associated wood is so perfectly identical with that of modern *Pinus* that there is no basis for a distinct genus.[b]

The article goes on to describe the origin of the several varieties of amber as now distinguished. On first exuding, the resin was dim and cloudy from the presence of a multitude of minute bubbles of sap diffused throughout it. But in drying, and perhaps by exposure to the heat of the sun, these gradually concentrated, enlarged, and were able to rise to the surface of the still soft mass, so that the resin could become clear. In these ways, Doctor Klebs believes that the varieties were produced which are designated as follows: Osseous or bony

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[a] World's Fair, St. Louis, 1904; Collective Exhibit of the German Amber Industry, shown by the Prussian Department of Trade and Industry; Prof. Dr. R. Klebs, manager and director; Guide, p. 60.

[b] Brit. Assoc. Adv. Sci., 1896. Reviewed in Mineral Resources U. S. for 1896.

amber (knochig); mottled osseous (bunt-knochig); oily or misty (bastard and flömig); and clear (klar). The rare green and reddish-brown tints may be due to some peculiar coloration of the original sap; the dark blue tint sometimes found is of foreign origin, caused by deposits of pyrite in minute cavities and cracks.

It may be noted here that the clearing of a fossil resin may be caused by some molecular change not understood, entirely apart from any question of bubbles. The fact is familiar to collectors of copal, for instance, that pieces which were originally dim will sometimes become perfectly transparent, from without inwards, in the course of a few years.

Professor Klebs illustrates the varieties above named from certain typical examples in the amber exhibit, specified by number. In the "knochiger Bernstein," the bony or pale opaque variety, "the bubbles have a diameter of 0.0008 to 0.004 mm., and the sum of all the bubble sections is equal to 0.04 to 0.52 of the entire section." After these illustrations Professor Klebs continues:

Besides this, we find a second type of amber, which had undergone an alteration before being deposited in the soil. Under the heat of the sun, or perhaps of forest fires engendered by lightning, the dim or in many cases already half-clear amber was sometimes melted again, so as to flow down in threads, scales, and stalactitic forms, which quickly hardened at the surface, thus preventing the subsequent streams from solidifying together into a complete mass. Thus arose another sort of amber, distinguished by its great clearness, somewhat higher specific gravity, and especially by its possessing a less degree of cohesion in the direction of its original flow than at right angles to it. The trade name of this sort of amber is Schlauben.

No illustration of this variety is especially cited from the exhibit, but similar forms are familiar in copal and other semifossilized resins.

Specimen No. 122 in the exhibit is of much archæological interest, consisting of amber beads from prehistoric tumuli, referred to a date as remote as 600 B. C.

At this point the article takes up the historical aspect of the subject as relating to Germany, passing over the early traditions of the amber trade with southern Europe.

HISTORY OF THE AMBER INDUSTRY IN GERMANY.

Doctor Klebs writes:

The first definite records of the amber industry in the middle ages are of the fourteenth century. There was a guild of amber turners in Brüges, which was followed by a similar one in Lübeck. Their work was limited to the making of rosaries; hence their name of paternoster makers. In 1399 there was in Königsberg a very skillful amber cutter who worked for the grand master, making artistic reliefs for altars, etc., which were composed of precious metals and incrusted with gems.

In the sixteenth century the amber industry had spread and assumed great dimensions. Königsberg especially produced a great variety of artistic wares in amber.

All the great works of art, of which there are splendid specimens in almost every museum, are of the seventeenth or eighteenth centuries. The imperial collections in St. Petersburg and Moscow, the Grüne Gewölbe (Green Vault) in Dresden, and the collection in Berlin possess real gems of art in amber work.

Especially celebrated is the amber chamber, a remarkable and original attraction of the imperial palace at Zaraskoje-Szelo, the furniture of which is composed of gifts of Frederick William I to Peter the Great and of Frederick the Great to Catherine. Amber was then very much employed for royal gifts to friendly courts and their embassies.

At the beginning of the nineteenth century the amber industry declined, but improved again gradually from 1872 onward; to-day it is still increasing.

So far as we can learn from historical records amber seems to have been in early times the absolute property of the finder. Later on the Dukes of Pomerania claimed it for themselves as far as to the confines of Danzig.

But when the "Ritterorden" (Order of Knights) took possession of Prussia in the thirteenth century, not only did they take over the monopoly of the Dukes of Pomerania, but extended this monopoly over the entire line from West to East Prussia. From this time on the knights were the owners of every piece of amber, and any finder was obliged to give it up to them for a small specified recompense. This law is still practically in force, and all the changes in the production and sale of amber during the last eight hundred years have been affected by it, with the usual result—dissension between producer and buyer. On the one hand has been the continual striving on the part of the knights to turn the prerogative into a direct monopoly in order to keep the determination of prices in their own hands and thus to rule the market; on the other hand, the efforts of the manufacturers to break through the monopoly so as to procure their raw amber as cheaply as possible. Side by side with this have been the earnest endeavors of the Government to remove abuses and to do justice to both sides.

After having parted with their amber fishing rights on the coast of Samland to the bishop of Samland in 1257, and with those on the coast of Danzig to the Danzig fishermen in 1312, and to the monastery of Oliva in 1340, the knights attempted to annul the contracts they had made and to get the monopoly back into their own hands. But not until after many unsuccessful attempts did they succeed (in the middle of the fifteenth century) in overcoming all the difficulties in their way. When in 1466 by the peace of Thorn a large portion of territory was alienated from the order, these alienated lands obtained a license by Polish law to extract amber on their own territory—a right which West Prussia succeeded in obtaining also on the partition of Poland in 1773, which right was thus lost to Samland. Accordingly our inland Pomeranian amber monopoly is limited to East Prussia and the diocese of Pomerania, while in other inland places the right of amber mining rests with the owner of the soil. It is otherwise with the right of collecting amber on the seashore. On the coast of Jutland, Schleswig, Mecklenburg, Rugen, and Neuvorpommern, it is the property of the owner of the shoreland. From the mouth of the Weichsel to Polsk near Danzig, the amber found is the property of the last-named city. On all other parts of the Baltic coast of West or East Prussia, as well as in the Pomeranian districts of Neu-Stettin, Dramburg, Belgard, and Butow, amber belongs to the State as a royal perogative.

Improved processes.—It was the late Moritz Becker who introduced entirely new methods of procuring amber. Instead of "sticking" he instituted diving; instead of cutting, mining; and in the deeper water of the sea he attacked the stores of amber with steam dredges. He established the steam dredging station at Schwarzort, the diving station at Brusterort, and the mines at Palmnicken, now carried on by the Prussian State. The open workings at Palmnicken extended rapidly by sections up to the neighboring villages of Kraxtepellen and Hubnicken, and are now carried on in the Annengrube (Annen mine). Great masses of blue earth are brought up from these workings, and thoroughly washed by enormous volumes of water, which carry away the sand and clay through sieves and drains and leave the amber. In 1902 there were brought up 125,076 cubic meters of blue earth, containing 406,397 kilograms of amber, or about 3½ kilograms (7.2 pounds) of amber to a cubic meter.

The amber procured in this way, however, is very much weathered on the outside, making it impossible for the manufacturers to test it as regards color, flaws, and other peculiarities, and thus to fix the use to which it can best be put. The shore amber, which the waves in their constant motion have polished against the sharp sand and which the heavy surf has pounded and broken, is very much preferred as an article of trade. Hence means must be taken to impart similar good qualities to the mined amber. What is done on a large scale by the waves is copied artificially at Palmnicken on a small scale. The amber taken from the blue earth is placed in great revolving barrels along with sand and water; these are kept in motion until the dark surface is removed and the amber has assumed a similar appearance to that taken out of the sea. Thus prepared, it is taken to the sorting rooms at Königsberg, where the chisel of the workman takes the place of the surf and divides the large pieces.

Production.—Very considerable quantities of amber have been brought up at Palmnicken. In 1901 the whole output was 406,000 kilos; in 1902, 406,397 kilos. In the last twenty years there have been obtained 1,716,178 kilos of large pieces, 1,920,450 kilos of medium-sized, and 4,820,212 of small, making a total of 8,456,840 kilos (18,604,248 pounds) of amber. The revenues which the Prussian State draws from the royal prerogative are correspondingly high. From 1803 to 1811 the amber industry had to receive a subsidy from the Government; after that, however, the revenues were as follows:

Government revenue from amber, 1770–1902.

Year.	Marks.	Year.	Marks.	Year.	Marks.	Year.	Marks.
1770	60,000	1825	34,000	1876	371,000	1898	660,000
1780	53,000	1865	41,000	1877	770,000	1899	826,817
1790	14,000	1870	199,000	1880	556,000	1900	1,019,210
1810	1,000	1871	230,000	1881	561,000	1901	1,539,273
1820	45,000	1873	252,000	1892	660,000	1902	1,599,243

In view of these high figures, one can not help asking the question, What has become of these enormous quantities of amber?

The year 1837 was a turning point in the history of the amber trade. The State farmed out the mining of amber along the shore to the adjacent communities. In consequence of this, the Samland shore villages began to prosper and rose from a miserable condition to be flourishing communities. This prosperity went on increasing year by year, and the revenues of the State increased at the same time.

In the year 1860 the amber trade received a great impetus through the enterprise of the firm of Stantien & Becker, to whose influence on amber mining I shall again refer. This firm went to work with such energy and foresight as to get the royal prerogative as a practical monopoly into their own hands. But the complaints of the manufacturers against the management of the firm became so urgent that the State decided to purchase their whole stock in trade; and thus on April 1, 1899, the exercise of the royal prerogative passed again into the hands of the Prussian State.

The extraction of amber.—As the location of amber is various, so is the manner of its extraction. It is to be assumed that in ancient times only that amber was found which was thrown up by the sea; but in the time of Pliny it was known that in Liguria and Scythia amber could also be obtained by digging. Not until 1585, however, have we any authentic records of the extraction of amber from the earth; this was at Lochstädt, a fortress of the Ritterorden, on the Frische-Nehrung, between Pillau and Königsberg.

The oldest picture of the home of amber and description of digging for it are given by Hartmann in 1677. In the same book there is a picture of fishermen with their nets fishing for amber. Both these pictures are sufficiently interesting to be added to this guide on pages 33 and 34.

In 1872 level mining in the high banks on the shore was resorted to; the digging followed the "Striped Sands," but the output was so poor that the attempt was soon given up. Not until the second half of the nineteenth century did the original source of the amber, the "blue earth," become known. Open workings were then established at several points on the northern and western shores. These were open excavations from which the soil was removed until the blue earth was reached at a depth of 90 feet or more. Enormous masses of earth had thus to be removed, for it was necessary to clear away 10,000 cubic meters of sand and clay to reach down through the funnel-shaped narrow excavation, and expose an area of only 2,500 square meters of the blue earth. As the soil cleared away was always thrown into the sea to become the sport of the waves, the government feared that the banks might be more worn away than by the ordinary action of the surf, and so it put a stop to these open cuttings.

While all these attempts were being made, the fishing for amber in the sea continued to yield the chief supply. When violent storms agitate the sea to a great depth, masses of seaweed are torn up, bringing up amber entangled with them. As amber weighs but little more than sea water, it does not sink immediately, but is carried along with the weeds and waves. Thus, after a heavy storm, one sees the sea covered over a great extent with a meadow-like surface of seaweed, and the people wait with anxiety to see at what point the floating mass will be cast ashore. If the sea breeze turns to a land breeze at the critical moment, there begins an eager struggle with the watery element. Even in the hardest winter weather the men dash into the surf, catching up the masses of seaweed in hand nets and throwing them in on the shore where their wives and children search through them for the precious treasure. The work must be quickly done, for in a few moments the amber might slip away from the entangling seaweed and begin to sink. There have been storms in November after which the people of one district have gathered 30,000 marks' worth of amber in a few hours. When the sea is smooth, amber is taken by so-called "sticking." The men see from the boats when there is a piece of amber of any size caught between rocks and stones at the bottom and seek to get it up by means of peculiarly constructed hooks and nets.

In former times merchants went to the shore after a favorable storm and bought roughly, by heaps, the amber which had been brought in. This sort of trading was naturally calculated to induce extensive speculation. It was again the late Moritz Becker, head of the firm of Stantien & Becker, who put an end to this speculation. When he had first placed mining in the blue earth on a paying footing, the market suddenly became flooded with such quantities of amber that it was impossible to dispose of it. Becker therefore introduced a system of exact sorting of the raw amber in order to allow the different branches of the industry to buy only that sort of amber which was suitable to their own trade. Thus every manufacturer gained the advantage of being able to concentrate his whole buying power on the kinds suitable to his own use, whereas previously he was forced to buy also other kinds which he could not use for himself but had to resell to others. This sorting system still prevails in the amber trade of to-day, and has been retained and extended under the state management.

Commercial products.—The subdivisions of raw amber for trade purposes fall under three heads, viz, pieces suitable for the manufacture of articles connected with smoking, those which can be used for beads and other ornaments, and those which from their small size can only serve to make varnish. The amber from which mouthpieces for cigars and cigarettes and tips for mouthpieces and pipes are made is called Fliesen or Platten, the former being the thicker and the latter the thinner pieces. In the manufacture of ornaments and beads, Grundstein and Bodenstein, Rund and Knibbel are used. To make varnish, the various Firniss sorts are utilized. Within these chief groups there are about 150 trade divisions distinguished partly by size and partly by coloring and purity. According to the number of pieces to a kilogram, the Fliesen are divided into about twenty grades. In Fliesen No. 0 there are from 2 to 3 pieces contained in a kilogram; in No. 1, from 10 to 12 pieces, while in No. 9 there are about 260. The rounder pieces are subdivided into about 18 sorts according to size; of the largest of these about 10 would go to a kilogram, of the smallest about 1,600. These are used chiefly for beads, from the coarser beads for export to less civilized countries to the pale yellow olive-shaped bead necklaces destined to gleam on the throat of an English or a Turkish lady, and from the clear-cut beads of Brunswick, France, and Russia, to the rosaries of the Roman Catholics and the Mohammedans.

The quantity of raw material produced, the exactness of its assortment, and the facility of traffic have raised the amber trade now to a point which no other period has even approximately reached. The best example of the increase in this industry is given by America, where the amber trade has increased five-fold within the last ten years.

The following tables relative to the amber trade are here given:

Value of amber used in America, 1891–1903.

Year.	Marks.	Year.	Marks.	Year.	Marks.	Year.	Marks.
1891	169,233	1895	300,061	1898	402,786	1901	618,297
1892	186,951	1896	407,733	1899	514,609	1902	834,522
1893	137,307	1897	354,736	1900	485,292	1903	885,332
1894	290,738						

Value of amber used in other countries, 1900–1902.

Country.	1900.	1901.	1902.
	Marks.	*Marks.*	*Marks.*
Germany	260,900	252,200	706,856
Austria	691,100	634,500	1,193,141
Russia	149,200	171,300	181,924
France	143,500	141,500	121,713
England	63,600	51,200	48,328
Turkey	60,300	68,700	75,214
Holland	1,800	1,900	1,723

Doctor Klebs enters into some account of the manufacture of amber articles as now developed. There is a large and varied production in north Germany of objects adapted to the tastes and peculiarities of many semicivilized or even barbarous peoples. These have much ethnographical interest, and a striking display of them is made in exhibit No. 124 by the Royal Amber Works at Königsberg, which was formed by Doctor Klebs and by Mr. A. Zausmer, of Danzig. Here are shown articles of special forms and color shades for exportation to different countries according to the local demand. Among them are beads and ear ornaments for the negroes of western and eastern Africa; red cylindrical beads for Japan; green round beads ("mandarin chains") and rings for China: sacred amulets for Morocco; a royal ornament for Korea, etc.

In the general exhibit modern artistic wares in amber are contributed by several firms.

August Richter, in Hamburg, sends a considerable collection of jewelry in real amber. Aside from the great manufacturing centers, this firm has arisen to be one of the largest of its kind, entirely through the energy of its head and without any extraneous aid whatever. Everything necessary to the complete fitting out of the many articles manufactured, from sheet metals and wires in different metals and alloys to the cards on which the finished articles are sewed, is produced in the factory. In a magnificent mechanical work room this firm makes all the machinery for the manufacture of their articles. Among these are especially noteworthy the complicated machines for the automatic production of buttons. In the last working year collar buttons alone to the value of 1,700,000 marks were manufactured by this firm. Latterly the establishment has been noted for the production of modern jewelry after the designs of celebrated artists, such as Bruno Kruse, Hans Dietrich, Leipheimer, Professor Kleeman, H. Baum, and others, and it offers an abundance of "motives" in necklaces, girdle buckles, chatelaines, etc.

Ambroid.—In spite of the manifold uses of amber, a great proportion of the middle sorts, too expensive for varnish, would have been practically lost for want of a use to put them to but for the invention of a method whereby small pieces may be pressed together by hydraulic power. Amber is insoluble in water and can not be melted by heat; but at a temperature between 170° and 190° C., it softens without disintegration to about the consistence of india rubber.

While in this state small pieces of amber are pressed together in the following manner: After being thoroughly cleansed and carefully freed by hand from the weathered crusts, they are placed on a very strong, deep, steel tray which is closed with a pot-like perforated cover. At a temperature of 200° C., these two vessels (the tray and its cover) are pressed together so that the amber in its softened state is forced up through the holes of the cover, where in cooling it solidifies into a mass. In this way, by hydraulic pressure, amber is obtained in the form of flat pieces which can be turned, bored, and polished like natural amber. It is harder than the natural material, but inferior to it in brilliancy.

The many difficulties which present themselves in preparing amber for pressing and the waste which takes place render pressed amber (ambroid) quite expensive, but the high price is counterbalanced by the increase in adaptability and the decrease of waste in turning. Pressed amber is therefore excellent for all cheap bulk articles, especially those used by smokers, in which the use of wood, horn, bone, celluloid, etc., is avoided for hygienic reasons, and a permanent good appearance is not required; but it is not adapted to fine manufactures. All pressed cloudy amber having the color of "bastard" undergoes a change in a very short time after use, which is apparent not only on the surface, but through the whole mass. The evenly distributed cloudiness seen at first becomes after a few months bony white, producing an uneven and disagreeable appearance. The clear sorts retain their original quality, but can not be compared to the natural amber in beauty and luster. The real amber will therefore always be preferred, except for those uses in which beauty and genuineness may be sacrificed to mere economy without too much loss.

It frequently occurs that dishonest dealers endeavor to sell pressed amber for the genuine, and it is therefore well to learn the distinguishing features. The natural clear amber is transparent through its entire mass and possesses a strong internal glow or "fire." The pressed amber is also transparent, but on close observation it can be seen to be not perfectly clear. It contains undulating lines and elevated portions which reflect the light in different ways, and recalls the aspect of two liquids of different densities—as glycerin and water—about to mingle, or of heated air, when passing into cooler, and often described as "trembling air." This distinguishing feature is typical and is best seen when the object examined is so placed that the light penetrates as large a mass of it as possible. It is more difficult to distinguish the cloudy sorts. There are convex layers of cloudy and clear parts in pressed amber, caused by the manufacturing process. These have the appearance of the well-known cirrus clouds. These layers show the direction of flow when pressed. If a cigar holder is cut parallel to this flow, the cloudy layers can be seen above one another, extending from the cigar end to the mouthpiece; or if it is cut at right angles to the flow they can be seen side by side across the holder. Such peculiar cloudy spots and bands are not found in genuine amber, and an experienced person can detect the structure immediately, or if not, a microscope will give very reliable evidence. In natural amber cloudiness is caused by a multitude of small bubbles, as already mentioned, which are round or somewhat oval and are surrounded by clear amber. In pressed amber the ground is seen to contain a large number of flat, crevice-like cavities which run in all directions or appear like moss. A mere fragment is sufficient for examination, and this can be procured with a knife from a spot which is not conspicuous.

The Royal Amber Works have placed on exhibition a pillar of pressed amber 7 meters high, designed by the architect Bruno Möhring, of Berlin. The rests of amber in the second pedestal inside the carved work of light gray maple are genuine amber.

Attempts to color an entire mass of amber have been recently successful, causing it to resemble other stones. This material can be easily turned and polished, and the colors are permanent. On account of its great durability and elegant appearance, colored amber will probably prove a substitute for several other materials used for decorative effect, where durability is required.

This seems especially to be the case in manufacturing doorknobs, window handles, and similar objects. For such purposes it can compete with ivory, the finest material known. Both are very valuable, neither conducts heat, and both are equally durable. Ivory, however, changes its hue very quickly and becomes yellow, whereas amber retains its color.

With regard to the source of amber, Doctor Klebs says:

What quantities of resin must these conifers have produced to have supplied the world for thousands of years. And how long will the supply hold out? Both these questions are pertinent. The first one is best answered by analogy with living trees. The fir-resin trade manages to destroy a respectable number of conifers for their supply of turpentine and gallipot resin by wounding the bark. The *Pinus nigra*, for example, between 60 and 80 years of age, produces from 4 to 10 kilos of turpentine and from 1 to 3 kilos of thick resin, in all about 120 kilos of thick resin; the *Pinus maritima* Poir., as much as 400 kilos of gallipot in the same time; *Abies excelsa* D. C., 220 kilos; *Pinus silvestris* L., 150 kilos; and even the *Larix europæa* L., which is poor in resin, 50 kilos of pure turpentine.

In order to come to definite figures, let us calculate the amber output of a single year. In 1902 there were 36,750 cubic meters of soil exhausted, and from that surface were taken 406,397 kilos of amber, or about 11 kilos to the cubic meter. A *Pinus nigra*, requiring a surface of about 10 square meters, produces from this surface 120 kilos of thick resin, or estimating the depth at one meter, 10 kilos more than the same surface of amber pine or *Pinites succinifer*. When one considers that not one tree, but generations of them, produced the amber, and that the blue earth was probably washed together from large areas, it will appear that in the formation of amber no other conditions need be assumed than those that prevail to-day.

The second question is also easily answered, as careful borings have shown that even at the present rate of excessive extraction there is blue earth enough to supply the demand for fifty or sixty years to come. Scientifically, however, it is more than probable that the amber-bearing stratum may extend so far into Samland as to provide a supply for a much longer time.

SANTO DOMINGO.

A very interesting occurrence of amber has recently been brought to notice on the island of Santo Domingo, in the Province of Santiago, in the Dominican Republic. The locality is at an altitude of 1,800 feet, near the top of a hill or mountain known as Palo Quemado (Burnt Post), at the headwaters of the Licey River, on a small branch called the Miguel Sanchez. It is situated about 30 miles inland from the coast, and lies some 10 miles northwest of Tambonil and 7 miles north of Santiago. The district was until lately almost unknown to travelers, but has recently been partly explored by Mr. C. W. Kempton, of the Progressive Mining Company of New York, from whom the following data have been obtained.

The amber occurs in a friable, disintegrated, and much broken sandstone, which at times becomes a conglomerate and is much impregnated with lignite. So much is this the case that the rock is mostly dark colored, and after a rain the water of the adjacent stream is often black with particles of the lignite. The pebbles of the conglomerate are chiefly siliceous, of varied colors, some of white quartz, well rounded, 2 or 3 inches in diameter, and smaller ones of rich red jasper. This rock is undoubtedly Tertiary, but its precise age is not known. Fossil leaves are reported as occurring in it in connection with the lignite and amber in groups or masses 2 inches across and one-eighth of an inch thick, but unfortunately no specimens were brought.

The amber itself is found loose in the soil and disintegrated rock, and also in the friable sandstone. It appears usually in ovate masses, from an inch or two to the size of a man's hand, round, sometimes flattened, dull on the exterior, and covered with a brown surface crust, like much of the Baltic amber and like buried resins generally. It possesses somewhat of the opalescent character of the beautiful amber from Roumania, and of that from Catania, Sicily, of which latter a very fine exhibit was made at the exposition in Milan in 1881. In color it varies from yellow to rich brown, resembling the amber found some years ago in the marl beds of New Jersey, but differing from it in always showing the petroleum-like fluorescence. It seems to exist in considerable quantity, and may prove very valuable for the manufacture of articles of ornament. The exterior is generally roughened from weathering.

There is a tradition that the natives used to burn a substance of this kind as incense in their religious rites, probably this amber; and it is said that they still do the same, burning all that they obtain. Its existence has been known for some time, reports of it having often reached Santiago; and it was recognized as amber by its electrical properties, attracting bits of paper, etc., after being rubbed on the clothing. But the region where it occurs is wild and inaccessible, and heretofore it has been almost impossible to ascertain any particulars about it.

It is very interesting to compare this occurrence with a somewhat similar one reported some years ago in a remote district in southern Mexico. From this district pieces of richly colored amber, with a fluorescence resembling the Sicilian, occasionally reached the coast through natives from the interior, who reported it as so abundant that they were wont to burn it. It is known that the Aztecs used amber as incense in some of their temple rites, and it was also employed for a like purpose in the Catholic churches in the early times of Spanish dominion in Mexico.[a] A very fine piece of this amber, perhaps the only one in the United States, is in the Field Columbian Museum at Chicago. The amber from Santo Domingo seems to have much the same characteristics as the Mexican. A number of pieces have been sent to the United States, the largest piece that has reached this country being about twice the size of a man's fist.

FLUORSPAR.

ILLINOIS.

Mr. H. Foster Bain, of the United States Geological Survey, communicates the statement that the old and celebrated Shawneetown region in southern Illinois has lately been yielding fluorite of remarkable beauty. Among some specimens recently sent to the writer for examination there were cleavage pieces of much elegance from several of these localities, notably the Empire mines and Cave-in-Rock. From the former were large cleavages of rich reddish purple and of the peculiar sea blue of that region. In one case the general appearance was of the latter color, clouded at points with the former—like the tint of a blue Alabashka topaz with included clouds of Uralian amethyst. Both the purple and the sea-blue varieties pass at times into almost colorless fluor. From Cave-in-Rock is an octahedral cleavage, perfectly transparent and of amber yellow. A cubical crystal from Rosiclare is pale bluish, passing into nearly colorless. This region from Cave-in-Rock to Rosiclare has produced many thousands of tons of fluorspar that have been used in the industries as a flux and for other purposes.

[a] Gems and Precious Stones of North America, 1890, p. 302.

MISCELLANEOUS.

PRECIOUS STONES OF PERU AND BOLIVIA.

The exploration by Dr. G. F. Bandelier of the tombs of the Incas and other graves in Peru and the Bolivian region has naturally been of great interest. Doctor Bandelier, whose work in anthropology in the Southwest and Mexico well equipped him for such an exploration and who belongs to the anthropological staff of the American Museum of Natural History, had every facility extended to him in his exploration, which has resulted in great collections of textiles and of all manner of objects used by the ancient Peruvians, so that this collection of the American Museum of Natural History is now one of the most complete known. Doctor Bandelier gives his observations on the occurrence of precious stones and gem minerals as a result of some eight years of investigation. These are of much value in connection with the statements that have appeared for four centuries touching this interesting region.

Antonio Raimondi, the noted Italian naturalist, to whose labors Peru is so much indebted, nowhere in his numerous treatises mentions the presence of gems in Peru or in northern and central Bolivia. During thirteen years of residence in Peru and upper Bolivia Doctor Bandelier could not find any authentic account of the location of any gem of practical value in either of the republics named.

With the interest for mining in Bolivia that has recently been awakened outside of its territorial limits, and particularly among North American prospectors, it is to be expected that discoveries of minerals which are considered precious when in a state of sufficient purity will sooner or later be made; but up to the time of Doctor Bandelier's investigation there had been no authentic finds of either diamonds, rubies, sapphires, emeralds, topazes, almandines, or zircons. The following are the stones of which Doctor Bandelier heard from reliable sources or that he actually saw:

Amethysts.—These occur in southern Bolivia, in the districts of Tarija and Tupiza.

Garnet.—A number of well crystallized and very characteristic specimens of melanite from the province of Inquisivi in the southern portions of the department of La Paz were seen, but while the species was unmistakable, the crystals were opaque and without any value commercially.

Tourmaline.—The common black variety accompanying cassiterite occurs near La Paz.

From southern Bolivia and from the vicinity of its former capital, Sucre, rubies and almandines are reported to appear in the sands of rivers. Diamonds are thought to exist, accompanying gold in the Tipuani gold district on the eastern slope of the Cordilleras. There is no impossibility that such reports may at some future time prove to be the shadows cast before real events. In the neighborhood of the city of La Paz there are streams carrying gold, with its usual accompaniment of titanic iron, wash tin, and metallic grains, the nature of which is yet undetermined. Such mineralogical associations may yet prove significant.

In regard to emerald, Doctor Bandelier states that this is the gem about which in those parts of South America more has been said than about any other. It is certain that many emeralds have existed in private hands for centuries past, since the times of the Spanish colonization. But the source whence these precious stones came, which are seen worn in rings, bracelets, and other articles of personal adornment, has never attracted due attention. Doctor Bandelier holds that never in any part of Peru (Bolivia included) did the emerald play an important part in the practical results of warlike spoils or in tribute as it did in Colombia. What is said in some mineralogical text-books relating to Peruvian emeralds is the result of geographical confusion, if not of ignorance. Emeralds were unquestionably met with at the beginning of the conquest, but not at all comparable in quantity with what Colombia yielded or with what was obtained on the Ecuadorian coast.

Hence, the number of emeralds that appeared at Cuzco, for instance, within the last century, after the interior of Peru became more accessible, is not to be ascribed to emerald localities in that region, but to the fact that the early colonists had easy opportunities for obtaining the highly prized stones from points under immediate Spanish sway and situated on the same side of the South American continent. It is much more than likely that all the emeralds at Cuzco, La Paz, and in the interior of Bolivia originally came from Muzo in Colombia, or, in very early days, from Ecuador. The number of emeralds at Cuzco is very great, or at least has been so, and there is yet a considerable quantity remaining, although in hands that would not permit commercial manipulation of them. At La Paz, some thirty years ago, the emeralds were extensively supplanted by modern imitations (by shrewd candidates for the acquisition of gems).

Most of the emeralds still met with at Cuzco, and on the highlands in general, have what is there called a "garden;" that is, they are impure in the sense that minute fissures traverse the otherwise well-colored stone. Such a gem with a "garden" is even looked upon with favor by many of the people. The cutting is usually very imperfect and the "cabochon" quite common. Everything tends to show that the gems were not originally obtained in the country, but were brought thither after the settlement by the Spaniards. Considerable wealth accumulated in the hands of early settlers, because gems could be obtained by them with much less outlay than is generally imagined.

Potosí, in Bolivia, affords an example of the lavishness with which precious metals were expended in order to obtain other luxuries.

Had the emerald been known and accessible to the Peruvian aborigines as a gem, it would have been found much more frequently in the excavation of ancient settlements, dwellings, or graves. As it is, there are hardly any such discoveries on record. Neither on the Peruvian coast nor in the highlands have they been met with, except very sporadically. A monetary value the Indian could not attach to any jewel, but a religious one he might have conceived. Doctor Bandelier knows of only one perfectly authentic finding of an emerald in Bolivia. This occurred in the vicinity of the now abandoned mining settlement of Sotalaya, north of Huarina and near Lake Titicaca. Here an emerald in the shape of a pear, very clear, and over an inch in length, was taken out of an ancient skull. The witchcraft practices of the present Indians, copied by them from their ancestors, makes it altogether probable that this gem was placed within the cranium long after the fifteenth century. It is now brilliantly cut and in private hands in Germany. The cutting has brought out the marvelous beauty of the jewel, but at the expense of its value as an antique.

Emeralds were never found anywhere by Doctor Bandelier in his numerous excavations both in Peru and Bolivia. But specimens of what is called emerald of Corocoro were obtained in western Bolivia. The formation in which these transparent green stones are met with is Permian. Many were taken to England and, if the reports from there are correct, were declared to be "soft" emeralds. An examination of the crystals proves them to be simply very handsome green fluorite, with the cubic form perfectly plain. And yet, to this day many believe in the "soft-emerald" explanation.

Excavations on the coast, and sometimes also in the interior, yield turquoise in the shape of beads and incrustations. No clue has yet been obtained to their locality. Raimondi also mentions the fact of their occurrence, without having been able to explain it or to determine the source of the mineral. As a general rule such substances as served for decorative or ceremonial purposes become more abundant in the ruins in proceeding from the interior to the coast, and in the interior as one gets within the range of the Inca influence.

Serpentine, nephrite, and possibly jadeite.—A number of greenish beads, some of large size, were sent to the museum by Doctor Bandelier, who was unable to determine to which of the three species they may belong. No locality of jadeite has as yet been discovered in Peru or Bolivia.

Lazulite.—Lazulite is quite common, and is found even occasionally in ruins in the Bolivian cordilleras. The locality is unknown, although lazulite occurs presumably in situ in the copper region of central

Bolivia, and perhaps near Ayacucho, in Peru. A fetich is reported as exhumed somewhere near Cuzco that represented a human figure of gold with lazulite; but, while such a thing is not impossible, the statement is doubtful.

The Spanish writers, from the sixteenth century and the century following, are explicit in limiting the localities where emeralds were found to the Muzo country, in Colombia (where the well-known emerald localities still exist), and to some unknown region in Ecuador. It should not be overlooked, in regard to the latter, that there is no evidence to the effect that it was on the Ecuadorian coast near the Manta or the Esmeraldas of to-day. It appears that the gems were in possession of the Indians at these points when the Spaniards first came in contact with them; but an author of great reliability, who wrote at the close of the sixteenth century and one who devoted some attention to the question of emeralds in South America, the Jesuit Joseph de Acosta, distinctly states that the emeralds of Manta came from the interior and from a region that had not been visited in his time. Hence the story that the emerald mines of the Ecuadorian coast were kept concealed by Indians, or were even covered up from the sight of the Spaniards, still requires critical investigation. Oviedo, who also mentions the emeralds of Manta, describes even the rock in which they are found; but it is likely that he took his description from what was known at his time of the emerald mines in Colombia. Of other gems, like diamonds, rubies, sapphires, etc., no mention is made in any authentic documents of that period.

PRECIOUS STONES OF ELBA.

Since the death of the distinguished Italian mineralogist, Giovanni D'Achiardi, professor of mineralogy at the University of Pisa, several papers have appeared from his pen. Besides their scientific value, these posthumous publications have a special interest as being the last contributions of the lamented author to the science of his country, to which he was so devoted.

The papers are as follows:

On the crystalline character of the quartz of Palombia, on the island of Elba, treating of its occurrence and crystallographic features.[a]

On the crystal form of beryl on the island of Elba, with illustrations of the complex character of the remarkable crystals.[b]

On the tourmalines found in the granite of San Piero in Campo, on the island of Elba. In this Professor D'Achiardi speaks of the associated minerals, pyrite, arsenopyrite, rutile, apatite, lepidolite, and

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[a] Processi verbali della Società Toscana di Scienze Naturali: Adunanza del dì 8 marzo 1903, Pisa, 1904, pp. 1-7.

[b] Estratto dai Processi della Società Toscana di Scienze Naturali: Adunanza del dì 13 marzo 1901, pp. 1-11.

stilbite. The locality in many ways resembles those of southern California, in San Diego and Riverside counties.[a]

PRECIOUS STONES OF THE PHILIPPINE ISLANDS.

In the exhibit of the Philippine Islands at St. Louis, Mo., there are a number of interesting gem stones. Some of these were procured by the collectors sent out by the Philippine Exposition Board: the rest were sent to the Exposition by the Mining Bureau, Manila. But little is known of the localities, no data accompanying the specimens.

Mr. Roy C. Hopping, of the Department of Mines of the Philippine Exhibit, describes these stones as follows:

Wood opal.—Wood opal is found on the mountains near Capas, Tarlac Province, Luzon Island. Capas is 60 miles north of Manila on the Manila and Dagupan Railroad. There is a large suite of specimens, gray, yellow, reddish-brown, and black, banded and mottled. They all have the semiopal glimmering luster. One specimen of white petrified wood was also procured at Capas.

Petrified wood.—Petrified wood occurs in the district of Zamboanga, Mindanao Island, the land of the Moros. Zamboanga is a peninsula on the west coast of Mindanao, about 400 miles south of Manila, with Borneo 250 miles southwest. The suite of specimens is white, red, and gray, one very striking specimen being pure white with a jet-black center.

Wood jasper.—Wood jasper and petrified wood is found at Mauban, Tayabas Province, Luzon Island. The specimens are large, white, porous limbs and trunks of trees, and heavy sections of compact, red and yellow mottled tree trunks. Mauban is 60 miles southwest from Manila on the opposite coast, a mile or so inland from Lamon Bay.

Chalcedony, blue chert, white agate, drusy, and vitreous quartzes.—These stones are found associated at San Miguel, Bulacan Province, Luzon Island. The specimens appear to be pieces of large nodules and geodes. The chalcedony is clear, translucent gray, the chert pretty mottled blue-gray, and the agate white, finely lined and banded. The quartz is drusy (lining cavities) and vitreous crystalline, of the crypto-crystalline varieties.

Fossil coral.—Fossil coral, siliceous, beautifully marked, translucent, and white, is represented by one specimen, broken from a weathered cliff or reef at San Miguel. San Miguel is an inland town among the mountains of Bulacan Province, 40 miles due north of Manila, and its important mineral industry is mining and smelting the high-grade steel ores which occur here and elsewhere in Bulacan. A well-known

[a] Estratto dai Processi verbali della Società Toscana di Scienze Naturali: Adunanza del dì 8 maggio 1904, pp. 1-9.

mineral spring is at Sibul (Tagalog, spring) not far from San Miguel. The water contains lime, chlorine, silica, and carbonic acid gas.

Agate jasper, jasper, and chalcedony.—These stones occur on the island of Panay, about 200 miles southeast of Manila. Most of the specimens are rounded bowlders, mottled red and yellow. One specimen of clear gray chalcedony, a partial nodule in green diorite, comes from Aniniy, Antique Province, Panay.

Mr. Hopping also quotes the following from an article by Mr. H. D. McCaskey, chief of the mining bureau, published in the Official Gazette for May, 1904:

> With the exception of opal, reported from Binangonan in Rizal, and some very small rubies, reported in the headwaters of streams flowing into the ocean near Mambulao and Paracale, no minerals have yet been identified as precious stones.

Mr. Hopping states that Binangonan is a basalt locality quite near Manila, and that Paracale is the center of the best known gold field. The island of Mindanao, the most probable gem field, is thus far almost entirely unexplored.

PRECIOUS STONES OF CEYLON.

In the report[a] issued in connection with the Ceylon court at the Louisiana Purchase Exposition at St. Louis, Mo., there is an admirable chapter on the mineral resources of Ceylon, by Mr. A. K. Coomaraswamy, that treats at some length of the graphite, mica, iron ore, and manganese, but the most interesting chapter of this report is that on gems. In this Mr. Coomaraswamy mentions the occurrence of the various forms of gems found upon the island, noting that the only gem at present actually mined from the rock is moonstone, the orthoclase variety being especially quarried in the Dumbara district of the Central Province. The silvery sheen suggested is probably due to incipient decomposition, minute flakes of kaolin being arranged in definite planes within the crystal. The best varieties are those in which the silvery sheen has a strong blue color. The large quantity of the stone which can be obtained prevents its commanding a very high price; from 75 to 100 rupees ($25 to $33) is the very highest price which the largest and best stones would fetch.

In regard to the remarkable garnet known as essonite, or cinnamon stone, he says:

> Garnets are likewise obtained *in situ*, though occurring also in the gravels. Garnets of small size, but brilliant color, are exceedingly abundant in many of the crystalline rocks; occasionally they are large enough and good enough for use as gems, and are then usually obtained by being picked out from partially decomposed portions of the rock. Cinnamon stone is a variety of garnet of a strong brownish-yellow color; it is not much valued. Of ordinary garnets those are best which have

[a] Official Handbook of the Ceylon Court, with Maps and Illustrations, George A. Skeen, government printer, Colombo, Ceylon, 1904, pp. 149-152.

a pink color without any shade of brown. Fine fiery specimens of garnets may be worth as much as 100 or 200 rupees ($33 or $66) or more, and cinnamon stones of a pure rich yellow color, and weighing 10 to 15 carats, may fetch as much as 500 or 600 rupees ($166 or $200). Of course the stones must be of perfect color and free from flaws to fetch these high prices.

It is interesting to note what is said about rubies. Varieties of corundum include the most important gem stones, ruby and sapphire.

Of these rubies are much the most valuable, it being very rarely that stones of any size without flaws are obtained. It is rarely also that the most perfect "pigeon's blood" color is found. A ruby of about 1 carat and of the best color and flawless fetches about 300 to 800 rupees ($100 to $266); as much as 15,000 rupees ($5,000) has been offered for an absolutely perfect ruby of 4 carats, but the price of 7,500 rupees ($2,500) for a perfect 6-carat stone, actually sold, was considered high.

Ceylon rubies are never the true red of the Burman, although often more brilliant, and hence are less valuable.

The varieties of chrysoberyl are very interesting. The cat's-eye is highly valued, and fine specimens have realized large sums, but it is affected by the caprice of fashion, not commanding general admiration as do the sapphire and the ruby; the result is that in some years its price is increased by a demand which in others as suddenly falls. There are inferior kinds of stones resembling cat's-eyes, such as the quartz cat's-eye and crocidolite, which is now stained to resemble the chrysoberyl or true cat's-eye, but in no case do these compare with the real cat's-eye, which is said to be peculiar to Ceylon. Although found in several districts, the finest have been produced from the gem pits of the Morawak corral.

In the same district, and it is said almost exclusively, there is found the beautiful gem called Alexandrite. This mineral was formerly found only in the northern part of the Russian Empire, and took its name from the Imperial family. The characteristic of this gem when really fine is its rich vivid green hue by day (much darker than the emerald and slightly bronzed), which by artificial light is completely changed to a deep red. Like the cat's-eye, this gem occasionally commands a high price in the European markets, and is sometimes sought after by Americans and Russians, who are often led to suppose that the stones are of Russian origin. In reality the Russian stones are finer in color and of greater beauty, but rarely over 2 carats in weight and very rare, whereas many Ceylon stones weigh from 10 to 20 carats each.

The stone known as zircon is classified under various names, according to slight variations of color or the imagination of the dealer who introduces it to the market. Its usual colors are various shades of brownish and yellowish red, showing in fine specimens a very fiery hue, which the ancients were wont to credit with supernatural powers. Many other qualities it was supposed to possess; among others the power of composing the wearer to sleep and protecting him from unseen enemies. Another kind of zircon is almost colorless; it is a whitish crystal with a faint smokiness, and is often spoken of as Matara diamond. It has, of course, no connection with the real diamond, although used to imitate rose diamonds in the eighteenth century.

In regard to beryls and emeralds he says that pale green beryls are found in large flawless crystals and sold under the name of aquamarine; it is only very occasionally that Ceylon beryls possess the true emerald color. This color has never been seen by the writer of this review although he has examined great quantities of gems from Ceylon.

Mr. Coomaraswamy closes his discussion as follows:

To the mineralogist the gems are of most interest in their uncut state and in connection with their mode of occurrence in the rock. Unfortunately most of the interesting gems of Ceylon have not yet been found *in situ*, but only as more or less water-worn pebbles in the river gravels of the Balangoda, Rakwana, and Ratnapura districts. Several new minerals have been found in the heavy refuse from gem washings during the last fifteen years, and it is possible that others remain to be discovered.

These observations are interesting in connection with the statements that have appeared in previous reports in which Barrington-Brown and others have attempted to show that the mining of precious stones in Ceylon by the compound system could not be successfully carried on owing to the cupidity of the natives, which renders it impossible for the operators to receive the return of all the gems or even the larger part thereof.

PREHISTORIC JEWELRY IN RUSSIAN TURKESTAN.

Prof. Raphael Pumpelly, who has been engaged in archæological investigations in Russian Turkestan under the auspices of the Carnegie Institution, has recently sent a letter to the president, Dr. Daniel C. Gilman, describing some remarkable discoveries in the vicinity of Anan, a few miles east of Aschabad. Here, near the ruins of that city, which was inhabited up to a century ago, are two very ancient mounds rising above the present level of the plain respectively 40 and 52 feet. These show a long succession of layers of remains, with pottery, etc., divisible into four marked stages, two in each. The earliest layer in one mound is wholly without evidence of metals, followed by one containing traces of bronze and lead; the other mound is chiefly of the more developed bronze age, with an upper stage in which traces of iron appear. In all these stages, save the last, Professor Pumpelly finds a peculiar custom of burying children under the houses, beneath a covering of fire-hardened earth. With these remains are found beads of various kinds, including especially carnelian, turquoise, and lapis-lazuli. The mining and use of these minerals and the traffic in them in this region are thus carried back into the later stone age.

THE CHESTER MINERALOGICAL COLLECTION.

The mineralogical collection of the late Prof. Albert H. Chester, of Rutgers College, New Brunswick, N. J., has been presented to that institution by his son, Mr. A. H. Chester, jr., a most generous and appropriate gift. The collection is a remarkably fine one, in its complete and typical illustrations of the field of mineralogy, and hence it is especially valuable for purposes of instruction. It includes 4,850 specimens, carefully selected and authenticated by Professor Chester, who was both a high authority and an excellent judge. He especially aimed at securing perfect and typical crystals, and also possessed a fine æsthetic taste in his choice of specimens, which enabled him to obtain those that were attractive as well as accurately illustrative.

In addition, Professor Chester's working library, gathered through many years with liberal expenditure of time and means, accompanies the specimens. This library was extremely full in the department of nomenclature, in which Professor Chester was a specialist, having written the most complete volume of mineralogical names and synonyms and being the editor of the mineralogical department of Murray's great dictionary. This library is probably the most complete of its peculiar kind in the United States.

WATCH JEWELS.

At no former period were watch jewels made so beautifully perfect as to mechanical accuracy. A certain number of jewels, often simply called stones, are used in every watch. A watch is said to run on so many stones, and though it can not strictly be said that the value of a watch increases with the number of stones used, still in an approximate sense it is true. This is indicated by the fact that during the last fifteen years, which have witnessed a very marked improvement in watches, the number of stones required for the works of a first-class watch has been increased by nine, and as millions of watches are made annually, the number of jewels annually sold is at least from 10,000,000 to 20,000,000. The little gems are pierced to receive the gearing of the axles of the wheels. The object of using them is to give to the works a base which shall cause the least friction and shall not wear out easily. Among the gems employed for this purpose garnet is the least valuable, but it is much used in the cheaper watches. Sapphires and rubies, fine enough in quality to make gems, are mostly used, but only minute pieces are necessary. For the most part, however, these gems are merely fragments of larger ones which have no color, or else are rolled crystals that are of such color as to have no value, and hence are not considered as jewels. This is especially true of sapphires too pale for setting, which, however, are a shade harder and hence more serviceable for watch stones, and of stones which, like the Fergus County, Mont., blue flat crystals, or the Granite County, Mont., multicolored crystals, have little value in jewelry. Many thousand ounces of these American gems are sold at from $1 to $5 per ounce, and are an important factor in American sapphire mining.

In Switzerland most of the jewels are cut and sold in boxes of from 500 to 1,000 per box. Each stone has been given a rounded form and is pierced in the center, the drill-hole being smaller by a minute quantity than the diameter of the axle which it is to hold. The bed of the stone in the watch is a small cylinder, apparently of brass, but in reality consisting of a soft-gold alloy. Before the stone is handed to the watchmaker it is put in a lathe, and by means of a tiny steel drill, covered with oil and diamond dust, the central opening is enlarged sufficiently to enable the steel axle or pin for which it is intended to fit into it accurately. The watchmaker first fixes the cylinder in the lathe, then picks up the stone with the moistened finger and inserts it in the cylinder while the latter is turning with the axis of the lathe. With a pointed tool the workman next presses against the edge of the revolving cylinder and thus forces the soft metal to cover and protect the sapphire or ruby to such an extent that it appears as if embedded in a metallic cushion. Next a drill is inserted in the metallic coat of the cylinder from the opposite side of the lathe, and a hole is drilled in this coat exactly of the same size as the hole in the stone itself. A great variety of forms have been made recently, not only for watches, but for electric and other meters. The latter, as compared with watches, require a greater and more enduring life in the jewels, which, owing to the microscopic inclusions, either of softer minerals or of fluid cavities, is often shortened materially. Sapphires, rubies, and even diamonds are used with wonderful ingenuity, and with the increasing demand for hard bearings in the endless variety of electrical devices, in which the moving points revolve rapidly, there is much to be looked for in the way of new devices, and a greatly increased demand for jeweled bearings is probable.

PRODUCTION.

In the following table is given a statement of the production of precious stones in the United States from 1897 to 1903, inclusive.

Production of precious stones in the United States, 1897–1903.

Stone.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Diamond	None.	None.	$300	$150	$100	None.	$50
Sapphire	$25,000	$55,000	68,000	75,000	90,000	$115,000	100,000
Ruby	None.	2,000	3,000	3,000	500	None.	None.
Topaz	None.	100	None.	None.	None.	None.	200
Beryl (aquamarine, etc.)	1,500	2,200	4,000	11,000	5,000	4,000	4,000
Beryl (pink)	....	....	....	....	....	....	200
Emerald	25	50	50	4,000	1,000	1,000	250
Phenacite	None.	None.	None.	None.	None.	None.	None.
Tourmaline	9,125	4,000	2,000	[illegible],500	15,000	30,000	45,000
Peridot	500	500	500	500	500	500	5,000
Quartz, crystal	12,000	17,000	12,000	10,000	10,000	12,000	10,000
Smoky quartz	1,000	1,000	None.	1,000	1,000	2,000	1,500
Rose quartz	None.	100	100	100	150	200	1,500
Amethyst	200	250	250	500	500	2,000	3,000
Prase	None.	None.	None.	None.	None.	None.	None.
Gold quartz	5,000	5,000	500	2,000	2,000	3,000	3,000
Rutilated quartz	None.	100	50	50	50	100	100
Dumortierite in quartz	None.	None.	None.	None.	None.	None.	None.
Tourmalinated quartz	None.	None.	None.	None.	1,000	None.	None.
Agate	1,000	1,000	1,000	1,000	1,000	1,000	2,000
Moss agate	1,000	1,000	1,000	1,000	500	500	1,400
Chrysoprase	None.	100	100	100	1,500	5,000	1,500
Silicified wood (silicified and opalized)	2,000	2,000	3,000	6,000	7,000	7,000	5,000
Opal	200	200	None.	None.	None.	150	200
Garnet (almandite)	7,000	5,000	5,000	500	100	None.	None.
Rhodolite	None.	None.	None.	20,000	21,000	1,500	1,000
Garnet (pyrope)	2,000	2,000	2,000	1,000	1,000	1,000	2,000
Topazolite	None.	None.	None.	None.	None.	None.	None.
Amazon stone	500	500	250	250	200	500	400
Oligoclase	25	10	20	20	None.	None.	None.
Moonstone	None.	None.	None.	None.	None.	None.	None.
Turquoise	55,000	50,000	72,000	82,000	118,000	130,000	110,000
Utahlite (compact variscite)	100	100	100	100	250	None.	100
Chlorastrolite	500	5,000	3,000	3,000	3,000	4,000	3,000
Mesolite (thomsonite, so called)	500	1,000	1,000	1,000	1,000	1,000	500
Prehnite	100	100	50	50	None.	None.	None.
Diopside	100	None.	None.	None.	None.	None.	None.
Epidote	None.	None.	None.	None.	None.	None.	None.
Pyrite	1,000	1,000	1,000	2,000	3,600	3,000	3,000
Malachite	None.	None.	250	200	100	None.	None.
Rutile	800	110	200	100	None.	None.	None.
Anthracite (ornaments)	1,000	1,000	2,000	2,000	2,000	2,000	2,000
Catlinite (pipestone)	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Fossil coral	500	500	50	50	100	None.	None.
Arrow points	1,000	1,000	1,000	1,000	500	None.	None.
Miscellaneous	....	....	....	....	....	....	13,500
Total	130,675	160,920	185,770	283,170	289,050	328,450	321,400

IMPORTS.

The following table shows the value of the diamonds and other precious stones imported into the United States from 1867 to 1903, inclusive:

Diamonds and other precious stones imported and entered for consumption in the United States, 1867–1903.

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	....	....	....	....	$1,817,420	$291	$1,818,617
1868	484	....	....	....	....	1,060,544	1,465	1,062,493
1869	445	$140	....	....	....	1,997,282	23	1,997,890
1870	9,372	71	....	....	....	1,768,824	1,504	1,779,271
1871	976	17	....	....	....	2,849,482	256	2,850,731
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	....	92,858	449,513	....	....	8,377,200	3,205	8,922,771
1883	....	82,628	443,996	....	....	7,598,176	[a] 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	8,949	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	....	....	[b] 12,429,395	....	13,105,691
1891	[c] 565,623	125,688	([d])	....	....	[e] 12,065,277	....	12,756,588
1892	532,246	144,487	....	....	....	[e] 13,845,118	....	14,521,851
1893	357,939	74,255	....	....	....	[e] 9,765,311	....	10,197,505
1894	82,081	53,691	....	....	....	[e] 7,291,342	....	7,427,214
1895	107,463	135,558	....	....	....	[e] 6,330,834	....	6,573,855
1896	78,990	65,690	....	([f])	([f])	[e] 4,474,311	....	4,618,991
1897	[g] 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	7,808,066	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
1903	10,634	720,150	10,275,800	675	13,020,367	2,494,897	....	26,522,523

[a] Not specified since 1883.
[b] Includes stones set and not specially provided for since 1890.
[c] 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.
[d] Included with diamonds and other stones from 1891 to 1896.
[e] Including rough or uncut diamonds.
[f] Not specified prior to 1897.
[g] Including also miners' and engravers', not set.

TALC AND SOAPSTONE.

By Joseph Hyde Pratt.

INTRODUCTION.

The notable changes in the talc industry during the year 1903 are the development of the new deposits in Georgia; the opening of deposits in Vermont, thus adding this State once more to those producing talc; the large decrease in the production of New York talc, due to strikes in the paper mills, and the increase in the import duty on ground talc.

The new deposits opened and developed in Georgia during 1903 are located near Ball Ground, Cherokee County, and near Canton, Cherokee County. These were not worked very extensively, but sufficient work was done on the Ball Ground deposit to show a large body of white talc, and a plant for grinding it is now being installed. The Vermont deposits are in Windsor County, and have been worked by two companies. Most of the talc (soapstone) was manufactured, there being but little of it put on the market as ground talc.

Owing to strikes in some of the paper mills during 1903, which caused them to be closed down for some time, there was a large decrease in the production of the fibrous talc from New York. Nearly all the talc mined in this State is sold to the paper manufacturers, and when, for any cause, there is any noticeable decrease in the quantity of paper manufactured, the production of the fibrous talc in New York is affected. The demand for this fibrous talc in the manufacture of paper is increasing with the increase of the manufacture of paper, for it gives much better satisfaction than clay, which is still used to some extent, but which was formerly used almost exclusively as a filler for paper. The talc has the advantage inasmuch as, besides acting as a filler, its fibrous character gives additional strength to the paper. Although some of the talc mined in the other States is used in the paper industry, none of them produce a talc that is used almost exclusively for this purpose, as is the case with the New York product.

There was some excitement in the talc trade during 1903, especially among the importers, owing to the placing of an import tax of 1 cent per pound on ground talc. It is considered dutiable at the same rate as French chalk, which is dutiable at the rate of 1 cent per pound under section 13 of the tariff act of July 24, 1897, which is as follows:

> Chalk (not medicinal nor prepared for toilet powders), when ground, precipitated naturally or artificially, or otherwise prepared, whether in the form of cubes, blocks, sticks, or disks, or otherwise, including tailor's pencils, billiard, red, or French chalk, 1 cent per pound. Manufactures of chalk not specially provided for in this act, 25 per centum ad valorem.

Although the two minerals are not the same, they are used in many cases for the same purposes. The imposition of this import tax on imported ground talc resulted in the advance of prices of domestic talc, especially by the producers in the South. In some instances an advance of as much as $10 per ton was reported. As a result of this duty, it is probable that there will be a decrease in the importation of ground talc and a corresponding increase in domestic ground talc, as the foreign talc, with a $20 per ton duty upon it, can not so easily compete with the domestic talc, even when the increase in the price of the domestic article is considered.

One result of this increase in the price of talc will be to stimulate prospecting for domestic deposits of talc that are suitable for manufacturing into ground talc, and to increase the production of the known deposits that are suitable for this purpose. Much of the talc mined is not suitable for the manufacture of ground talc, but is used in the manufacture of washtubs, laboratory sinks, etc. It may be of interest to give in this connection a synopsis of the talc localities in the United States that were noted in the reports for 1900, 1901, and 1902.

OCCURRENCES AND LOCALITIES.

Talc is found in greater or less quantity in nearly every State along the Atlantic slope, the deposits of best quality being in New York and North Carolina. The other States that have produced talc or soapstone are New Hampshire, Vermont, Massachusetts, New Jersey, Pennsylvania, Maryland, Virginia, Georgia, and California.

New York.—The talc deposits of New York are in Edwards and Fowler townships of St. Lawrence County, and occur in a belt of impure limestone which crosses a portion of these townships for a distance of 7 or 8 miles. The principal mines are located near Talcville, Edwardsville Township, and near Little York, Fowler Township. There has been a consolidation of a number of the smaller properties, so that they are now worked more systematically and on a larger scale.

North Carolina.—In North Carolina the talc deposits are found in Swain, Cherokee, Jackson, and Madison counties. In the two former counties, which produce by far the largest amount, the talc occurs for the most part between strata of marble and quartzite. The principal mining is in the vicinity of Hewitts and Nantahala, Swain County, and a few miles east of Murphy, and in the vicinity of Kinsey, Cherokee County. The pyrophyllite deposits of Moore County are mined to some extent, the product being used for various purposes; but it is not so good in quality as the genuine talc, and does not command so high a price.

Massachusetts.—The Massachusetts talc deposits are located near Dalton, Berkshire County, and are worked by drifting and shafting. The talc is foliated, and all that is mined is ground to a flour talc.

Vermont.—The Vermont deposits are in the town of Rochester, Windsor County, about 3 miles southeast of the village of Rochester.

New Jersey.—In Warren County, N. J., a soapstone vein has been encountered which has a northeast-southwest strike. It is worked by the Lizzie Clay and Pulpstone Company, which has an open quarry on the bank of the Delaware River, about 20 feet above the water. This deposit has been worked almost continuously for twenty years, and there have been over 50,000 tons of talc taken out, nearly all of which has been ground to a powder, the larger proportion being used in the manufacture of paper. The tailings from the bolting of the ground talc are used to some considerable extent by roofing-paper manufacturers and others.

Pennsylvania.—This same vein of talc outcrops across the river on the Pennsylvania side, in the vicinity of Easton, Northampton County, and is worked extensively. The general width of the soapstone belt is from 500 to 600 feet, and it is associated with limestone. Practically all of this Pennsylvania and New Jersey talc or soapstone, which is almost identical in appearance and quality, is put on the market in the form of a ground product.

Maryland.—Talc deposits have been worked in Maryland by Mr. H. A. Weldy, in Howard County. Near Westminster, Carroll County, soapstone deposits are reported, which contain fine stone that is capable of being mined in large blocks, and is also of sufficient purity for grinding. A small amount of this soapstone was ground during the last year. These deposits are owned by Thomas & Son, of Westminster.

Virginia.—The Virginia deposits are, for the most part, the steatite variety of talc, some of which is used for manufacturing into wash-tubs, etc. A considerable quantity of this soapstone was formerly used in the manufacture of slate pencils, but very little is now used for this purpose. Mr. B. H. Hester, of Oakland, Louisa County, reports the occurrence of a deposit of soapstone of very good quality in that section. In the vicinity of Wiehle, Fairfax County, a fibrous talc has been obtained in some quantity. Another deposit of talc is about 4 miles from Schuyler, Nelson County.

Georgia.—The occurrence of talc in Georgia is somewhat similar to that of North Carolina, and the formation is probably a continuation of it, but the talc is more compact and is not so fine in quality. The principal mining has been done in Murray County, 2 miles east of Dalton. There is a deposit of white talc 2 miles from Ballground, Cherokee County, and another deposit of talc near Canton, Cherokee County. About one-half of the talc mined in Georgia is put on the market in the form of ground talc.

Washington.—About 7 miles above Marblemount, Skagit County, Wash., on Skagit River, a talc deposit has been developed by Messrs. T. M. and E. H. Alvord, of Marblemount. No talc has thus far been put on the market, but a mill for grinding is near completion, and they expect to be producers of this mineral in 1904.

California.—In California talc is known to occur in quantity near Castella, Shasta County, but high transportation charges are at the present time prohibitory to profitable mining. On Catalina Island, Los Angeles County, there is a deposit of serpentine that is being operated and its product used for the same purposes as talc.

PRODUCTION.

The total production of talc and soapstone of all varieties during 1903 was 86,901 short tons, valued at $840,060, as compared with 97,954 tons, valued at $1,140,507, in 1902. This is a decrease of 11,053 tons in amount and of $300,447 in value and is due to the large decrease in the production of the fibrous talc in New York.

PRODUCTION IN ALL STATES EXCLUSIVE OF NEW YORK.

Of this 1903 production, 26,671 short tons, valued at $418,460, were obtained from all the States exclusive of New York, a decrease of only 183 tons in quantity, but of $106,697 in value, as compared with the production of 26,854 short tons, valued at $525,157, in 1902. This large decrease in value is due to the lower prices received for manufactured articles. As will be seen further on, the average price per ton received for the ground talc was higher in 1903 than in 1902. The value given above includes that of the manufactured product made from the talc, there being but a small amount of the production sold in the crude state. The production is classified, therefore, as it is marketed, as rough, sawed into slabs, manufactured articles, and ground talc. The variation that will be noticed 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 the articles manufactured being much more expensive, as was the case in 1902, than in other years.

The following table gives the production and value of the talc and soapstone produced in the United States (exclusive of the State of New York) from 1893 to 1903, inclusive, according to the condition in which it was marketed.

Production of talc and soapstone, 1893–1903.

Condition in which marketed.	1893.		1894.		1895.		1896.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	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
Sawed into slabs	104	4,400	1,303	19,500	863	12,320	923	15,481
Manufactured articles[a]	7,070	123,600	6,425	244,000	10,789	170,791	10,133	232,261
Ground[b]	8,137	75,467	9,796	87,045	8,802	74,498	9,577	92,948
Total[c]	21,071	255,067	23,144	401,325	21,495	266,495	22,183	354,065

Condition in which marketed.	1897.		1898.		1899.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Rough	1,020	$12,535	1,380	$16,453	1,540	$18,800	3,086	$32,458
Sawed into slabs	1,107	21,726	1,305	13,240	1,499	12,392	1,065	19,520
Manufactured articles[a]	12,095	267,583	11,336	191,923	12,377	[d]229,310	10,551	174,270
Ground[b]	7,701	63,785	8,210	65,496	9,349	70,303	13,241	157,293
Total[c]	21,923	365,629	22,231	287,112	24,765	330,805	27,943	383,541

Condition in which marketed.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Rough	3,920	$30,874	2,816	$20,036	2,908	$23,704
Sawed into slabs	225	4,261	436	7,722	2,027	33,800
Manufactured articles[a]	12,618	257,146	13,476	412,028	12,219	274,978
Ground[b]	11,880	132,607	10,126	85,371	9,517	85,978
Total[c]	28,643	424,888	26,854	525,157	26,671	418,460

[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 this table, there was a slight increase in the quantity of rough talc sold in 1903. Nearly one-half of this rough talc was of North Carolina production. There was a large increase in the quantity of talc sawed into slabs, the quantity in 1903 being the greatest of any year in the last ten years. The most noticeable change is in the value of manufactured products, the quantity of which was a little over 1,000 tons less than in 1902, but the value was $137,050 less. The production of ground talc was a little less than in 1902, but its value was somewhat greater. The 1903 production averaged $9.03 per ton, while that of 1902 was $8.43 per ton. The variation in price of the 1903 production of ground talc was from $5.20 to $20 per ton. The value of the ground talc used in the manufacture of paper was almost uniformly $7 per ton.

The States from which the above production was obtained and the number of producers in each were as follows: California, 1; Georgia, 4; Maryland, 1; Massachusetts, 1; New Jersey, 1; North Carolina, 7; Pennsylvania, 2; Vermont, 2; and Virginia 2; a total of 9 States and 21 producers. As there was only one producer in a number of the States it has been necessary to group them together in giving the production by States. In the following tables are given the production, by States, in 1902 and 1903, and also the production from 1898 to 1901:

Production of talc and soapstone in 1902 and 1903, by States, exclusive of New York.

State.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
New Jersey and Pennsylvania	7,062	$52,812	5,412	$44,068
Maryland and Virginia	13,221	372,163	13,118	243,552
North Carolina	5,239	88,962	5,330	76,964
Georgia	(a)	....	1,012	9,042
Other States b	1,312	11,220	1,799	44,824
Total	26,854	525,157	26,671	418,460

a Included in "Other States" in 1902.
b California, Massachusetts, and Georgia in 1902, and California, Massachusetts, and Vermont in 1903.

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.

Vermont, which had made no production of talc in 1902, was again a producer in 1903, and added considerably to the year's output. There was a large increase in the Georgia production, although its total is still small. In North Carolina there was a slight increase in the tonnage, amounting to 92 tons, but a considerable decrease in the value, to the extent of $11,978.

PRODUCTION IN NEW YORK.

The production of fibrous talc in New York in 1903 amounted to 60,230 short tons, valued at $421,600, as compared with 71,100 short tons, valued at $615,350. This is a loss of 10,870 tons in quantity and of $193,750 in value. As already explained, the chief reason for this large decrease in production is due to the long and protracted strikes at some of the paper mills. The average price per ton in 1903 was $7, while in 1902 it was $8.65, a decrease of $1.65 per ton. All of the production of 1903 was put on the market as ground talc, most of it being used as a paper filler. In the table below is shown the production of fibrous talc in New York since 1897.

Disposition of fibrous talc produced since 1897 in New York.

Use.	1897.		1898.		1899.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*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	63,500	$499,500
Total	57,009	396,936	54,356	411,430	54,655	438,150	63,500	499,500

Use.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Sold crude	200	$600	100	$350	....	....
Paper filling, Paint, Wall plasters	69,000	483,000	71,000	615,000	60,230	$421,600
Total	69,200	483,600	71,100	615,350	60,230	421,600

The production of fibrous talc in 1903 is the lowest in tonnage since 1899, when the production was 54,155 short tons, valued at $436,900. Usually the production of New York talc is double in tonnage and about the same in value as that produced in all other States; in 1903, however, the tonnage was more than double but the value only a little more than that of the other States.

TOTAL PRODUCTION.

In the following table are given the quantity and the value of the talc and soapstone produced in the United States since 1880, the production of New York being given separately from the combined production of the other States.

Production of talc and soapstone in the United States, 1880–1903.

Year.	New York.		All other States.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1880	4,210	$54,730	8,441	$66,665	12,651	$121,395
1881	5,000	60,000	7,000	75,000	12,000	135,000
1882	6,000	75,000	6,000	90,000	12,000	165,000
1883	6,000	75,000	8,000	150,000	14,000	225,000
1884	10,000	110,000	10,000	200,000	20,000	310,000
1885	10,000	110,000	10,000	200,000	20,000	310,000
1886	12,000	125,000	12,000	225,000	24,000	350,000
1887	15,000	160,000	12,000	225,000	27,000	385,000
1888	20,000	210,000	15,000	250,000	35,000	460,000
1889	23,746	244,170	12,715	231,708	36,461	475,878
1890	41,354	389,196	13,670	252,309	55,024	641,505
1891	53,054	493,068	16,514	243,981	69,568	737,049
1892	41,945	472,485	23,908	437,449	65,853	909,934
1893	35,861	403,436	21,071	255,067	56,932	658,503
1894	39,906	435,060	23,144	401,325	63,050	836,385
1895	39,240	370,897	21,495	266,495	60,735	637,392
1896	46,089	399,443	22,183	354,065	68,272	753,508
1897	57,009	396,936	21,923	365,629	78,932	762,565
1898	54,356	411,430	22,231	287,112	76,587	698,542
1899	54,655	438,150	24,765	330,805	79,420	768,955
1900	63,500	499,500	27,943	383,541	91,443	883,041
1901	69,200	483,600	28,643	424,888	97,843	908,488
1902	71,100	615,350	26,854	525,057	97,954	1,140,407
1903	60,230	421,600	26,671	418,460	86,901	840,060

IMPORTS.

Since 1889 the quantity of talc imported into the United States has been very irregular, owing partly to the development of deposits of first-class talc in this country, which furnish a product equal in quality to the French or the Italian, of which most of the imported material consists. The imposition of a 1-cent per pound import duty will have a still further tendency to reduce the amount of talc imported. The quantity and value of the talc imported into the United States since 1880 are given in the following table:

Talc imported into the United States, 1880–1903.

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	6,315
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	1903	1,791	19,677

[a] Quantity not reported previous to 1888.

During the last few years nearly all of the talc imported has been in the form of the ground product.

CANADIAN PRODUCTION.

There is but little talc produced in Canada, and the product varies widely from year to year both in tonnage and value. In the table below is given the quantity and value of the Canadian production since 1886, the table having been compiled from figures obtained from the Geological Survey of Canada.

Production of soapstone in Canada, 1886–1903.

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	1903	688	2,064

ABRASIVE MATERIALS.

By Joseph Hyde Pratt.

INTRODUCTION.

The abrasive materials are an interesting and important group of mineral products on account of their close relation to so many manufacturing industries. But few people understand and appreciate to how great an extent the arts are dependent upon these abrasive materials, and know their value, uses, and occurrence. It is not always the hardest abrasive that gives the best satisfaction for a given piece of work, and it is necessary to select not only the kind of abrasive but also the grade of that particular kind suitable to the nature of the abrasion that it is desired to make. An abrasive that will give satisfaction in one instance will not necessarily do so in another instance.

There are many kinds of abrasive materials on the market, some being natural products and others artificial, and they readily arrange themselves into three general groups, as follows:

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, scythestones, 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.

The abrasive materials included under these three heads and treated in this report are as follows: Oilstones and scythestones, grindstones and pulpstones, buhrstones and millstones, pumice, infusorial earth and tripoli, crystalline quartz, garnet, corundum and emery, feldspar, carborundum, crushed steel, artificial corundum, and adamite.

All of the above products are not used exclusively for abrasive purposes, and in some cases only a small part of the production is actually used as an abrasive material. With the exception, however, of infusorial earth and tripoli, only that portion of the production of the various abrasive materials that is used for abrasive purposes is included in this report. In the case of infusorial earth and tripoli, the total production is not large, and it is therefore all included under the one head.

From year to year there is a noticeable variation in the quantity of the different kinds of abrasives produced, which is due partly to the replacement of a certain abrasive by another natural product or by an artificial abrasive; and partly also to the closing down of certain of the mines, owing to their being exhausted or to the excessive expense of carrying on the mining operations. In the latter case the loss in the domestic production is often made up by the importation of that particular abrasive. In the aggregate, however, there is an increase in the amount of abrasive materials produced each year. This is the natural outcome of the continuous growth of our manufacturing industries.

The aggregate value of the production of abrasive materials in 1903 is the largest on record since these statistics have been collected, and amounted to $1,493,303. As compared with the value of the 1902 production of $1,326,755, this is an increase of $166,548. The values of the different abrasives produced in the United States for the years 1900 to 1903, inclusive, are given in the following table:

Value of abrasives produced in the United States during 1900, 1901, 1902, and 1903.

Kind of abrasive.	1900.	1901.	1902.	1903.
Oilstones and scythestones	$174,087	$158,300	$221,762	$366,857
Grindstones	710,026	580,703	667,431	721,446
Buhrstones and millstones	32,858	57,179	59,808	52,552
Pumice	....	....	2,750	2,665
Infusorial earth and tripoli	24,207	52,950	53,244	76,273
Crystalline quartz	40,705	41,500	84,335	76,908
Garnet	123,475	158,100	132,820	132,500
Corundum and emery	102,715	146,040	104,605	64,102
Total	1,208,073	1,194,772	1,326,755	1,493,303

As is seen from this table, there was a large increase in 1903 in the value of the production of oilstones and scythestones, and of grindstones and pulpstones, and a considerable gain in infusorial earth, and it is to be noted also that the value of the 1903 production of each of these three abrasive materials is the highest since these statistics began to be collected in 1880. The other abrasives showed a decrease in 1903 in the value of their production, and in the case of corundum and emery the value is the lowest on record for any year. The consumption of this abrasive in the United States in 1903 was about the same as the year before, and the deficiency in production was supplied by the imports.

In addition to the value of the natural abrasives, the estimated value of the artificial abrasives amounted to $493,815, an increase of $103,570 as compared with the estimated value of $390,245 of the 1902 production. The quantity of the two artificial abrasives, carborundum and crushed steel, produced in the United States since 1900 is given in the following table:

Artificial abrasives produced in the United States during 1900, 1901, 1902, and 1903.

Kind of abrasive.	1900.	1901.	1902.	1903.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
Carborundum	2,634,900	3,838,175	3,741,500	4,759,890
Crushed steel	700,000	690,000	735,000	755,000

The importation of certain abrasive materials still further swells the total value of the abrasives used in the United States. In 1903 the total value of the abrasives imported was $621,585, as compared with $426,736 in 1902, an increase of $194,849. This brings the total value of the abrasive materials consumed in the United States in 1903 to $2,608,603, which is $464,867 more than the value, $2,143,736, of the 1902 consumption. In the following table is given the total estimated value of all the abrasive materials consumed in the United States for the years 1900 to 1903, inclusive:

Total value of all abrasive materials consumed in the United States, 1900–1903.

Year.	Natural abrasives.	Artificial abrasives.	Imports.	Total value.
1900	$1,208,073	$275,641	$400,307	$1,884,021
1901	1,194,772	383,386	490,712	2,068,870
1902	1,326,755	390,245	426,736	2,143,736
1903	1,493,203	493,815	621,585	2,608,603

These totals should be reduced probably by $100,000 to represent the value of the abrasive materials exported from the United States.

Twenty-one different States contributed to the production of 1903, and they are given below in the order of the value of their respective productions, together with the kind of abrasive mined.

List of States producing abrasives in 1903.

1. Ohio: Grindstones, pulpstones, oilstones, and scythestones.
2. New York: Millstones, infusorial earth, garnet, and emery.
3. New Hampshire: Oilstones, scythestones, and infusorial earth.
4. Arkansas: Oilstones.
5. Michigan: Grindstones and scythestones.
6. Connecticut: Quartz and garnet.
7. Missouri: Grindstones and infusorial earth.
8. Vermont: Scythestones and millstones.
9. Indiana: Oilstones.
10. Virginia: Millstones and infusorial earth.
11. North Carolina: Millstones, garnet, and corundum.
12. Massachusetts: Infusorial earth and emery.
13. Pennsylvania: Millstones, quartz, and garnet.

14. MONTANA: Grindstones and corundum.
15. CALIFORNIA: Infusorial earth and quartz.
16. NEBRASKA: Pumice.
17. KENTUCKY: Oilstones.
18. MARYLAND: Infusorial earth.
19. KANSAS: Emery.
20. GEORGIA: Infusorial earth.
21. FLORIDA: Infusorial earth.

OILSTONES AND SCYTHESTONES.

There were no new localities producing oilstones and scythestones in 1903, the production being obtained from the old localities in Arkansas, Indiana, Kentucky, Michigan, Ohio, New Hampshire, and Vermont. In the two latter States the material mined is a quartz-schist; in the others it is a sandstone. There is included under this head all kinds of oilstones, whetstones, water hones, knife sharpeners of all varieties, razor hones, dental points, etc. The novaculite (sandstone) of Arkansas is the most valuable of all the abrasives of this class on the market.

PRODUCTION.

Notwithstanding the decided increase in the production of oilstones and scythestones in the United States in 1902 as compared with 1901, there was a still larger increase in the production of 1903, which was valued at $366,857. This is an increase of $145,095 as compared with the value of the 1902 production, $221,762, which in turn was an increase of $63,462 over the value of the 1901 production, $158,300. This is also the highest recorded value for these abrasives. The increase is due partly to the large demand for the Arkansas and Wichita oilstones, made from the Arkansas novaculite, which bring the highest price of any oilstone or scythestone made, and to the increase in the exportation of scythestones and oilstones. In nearly every instance the producers of the materials used in the manufacture of oilstones and scythestones are also the manufacturers of the finished or marketable product, and for this reason it is the value of the finished stone instead of the raw material that is given in these statistics.

The 1903 production was obtained from the following States, given in the order of the value of their production: New Hampshire, Arkansas, Vermont, Indiana, Ohio, Michigan, and Kentucky. There were eighteen producers of the oilstones and scythestones in these States.

In the following table is given the value of the oilstones and scythestones produced in the United States from 1891 to 1903, inclusive:

Value of oilstones and whetstones produced in the United States, 1891–1903.

Year.	Value.	Year.	Value.
1891	$150,000	1898	$180,486
1892	146,730	1899	208,283
1893	135,173	1900	174,0[illegible]7
1894	136,873	1901	158,300
1895	155,881	1902	221,762
1896	127,098	1903	366,857
1897	149,970		

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 of 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.

Notwithstanding the very large increase in the production of oilstones, scythestones, etc., in the United States, there is imported each year a considerable quantity of razor hones from Germany and Belgium, and a variety of oilstones known as the "Turkey" oilstone, from France and Italy. In 1903 the value of these imported stones amounted to $65,763. This is about one-fifth the value of the domestic production. There has been considerable variation in the imports of oilstones and whetstones from year to year, and since 1891 they have ranged in value from one-fifth to one-third of the value of the domestic production. The year of greatest comparative importation was 1901, when the value of the oilstones and razor hones imported amounted to $64,655, and the value of the domestic production was only $158,300.

In the following table there is given the total value of all kinds of hones and oilstones imported into the United States since 1880:

Imports of hones and whetstones, 1880–1903.

Year ending—	Value.	Year ending—	Value.
June 30—		December 31—	
1880	$14,185	1892	$23,420
1881	16,631	1893	25,301
1882	27,882	1894	26,671
1883	30,178	1895	32,439
1884	26,513	1896	50,588
1885	21,484	1897	34,435
December 31—		1898	30,856
1886	21,141	1899	34,510
1887	24,093	1900	39,316
1888	30,676	1901	64,655
1889	27,400	1902	56,456
1890	37,454	1903	65,763
1891	35,844		

EXPORTS.

The exportation of American oilstones and scythestones is steadily increasing, but as no separate record is kept of the exports of these stones no definite valuation can be given. It is, however, very probable that the value of the exports now exceeds the value of the imports. There is a considerable demand abroad for New Hampshire scythestones, which make up a large portion of the material exported. There is also a growing demand for the Arkansas oilstones. Besides these there are smaller amounts of Indiana oilstones exported.

GRINDSTONES AND PULPSTONES.

Although sandstone suitable for manufacturing into grindstones is known to occur in many of the States, there are only a few that have these deposits so situated that they make commercial propositions. During 1903 grindstones were produced in Michigan, Missouri, Montana, Ohio, and West Virginia with, however, over one-half of the production from the one State, Ohio. The grindstones that are manufactured in Montana are used locally, but the Montana Sandstone Company, of Butte, Mont., which is producing this stone, expects to be able to manufacture a grindstone that will give good satisfaction in the optical industry. The stone has been tested by Riehle Brothers Testing Machine Company of Philadelphia, who reported the following tests made on 3-inch cube samples:[a]

Subjected to the frost test, the specimen was frozen twelve hours at 6° F. above zero, then placed in water at 70°, raised to 212°, and maintained for five hours. The specimen showed no evil effects from the test.

[a] Eighth Biennial Report, Bureau of Agriculture, Labor, and Industry of Montana, 1901-2.

Subjected to compression, the specimen spawled at 57,000 pounds pressure, and broke at 76,000 pounds.

Subjected to the absorption test, the weight of the specimen, after drying five hours at 212° F., was 1,194.5 grams. Weight of specimen after boiling five hours at 212° F. was 1,243 grams. Increased weight due to absorption, 48.5 grams, equal to 3.9 per cent absorption.

Subjected to specific gravity test, the weight of the specimen in air, after drying five hours at 212° F., was 1,217.5 grams. Weight of specimen in water, 701.9 grams. Specific gravity, 2.34.

Specimen subjected to abrasion test was dried five hours at 212° F., after which it weighed 1,217.5 grams. The weight of this specimen after abrasion at 30 pounds mean pressure was 1,022.6 grams, equal to 16 per cent loss.

Near Buckhannon, W. Va., a sandstone deposit has been developed and experimented with by the Buckhannon Marble and Granite Company, which is now manufacturing a grindstone for the glass-cutters' trade. The company has two grits, a coarse and a fine one, which are of very even texture, and if large blocks can be obtained, like the samples examined, they should make grindstones of superior quality. A considerable quantity of the grindstones imported are used by glass cutters and in optical works, and if the Montana and especially the West Virginia deposits can furnish a good stone, adapted for the glass-workers' industry, they should be able to enter into successful competition with the foreign stones.

At Griesel, Mo., a small number of grindstones were manufactured by Mr. Charles A. White, and thus another State is added to those that are producers of this class of abrasives.

PRODUCTION.

The production of grindstones and pulpstones in 1903 was confined to Michigan, Missouri, Montana, Ohio, and West Virginia, with by far the largest amount from Ohio, which was the only State that produced any pulpstones. The total value of all kinds of grindstones produced in 1903 was $721,446, which is $54,015 greater than the value of the 1902 production, $667,431. This value is the greatest recorded for the production of grindstones during any year since these statistics were first collected in 1880, being $11,420 greater than the value of the 1900 production, $710,026, which was the previous greatest value. 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 average value per ton has decreased from $15 to $18 per ton to from $8 to $11 per ton, these values being exclusive of pulpstones. Consequently the actual tonnage of grindstones produced in the last five years is greater than for previous years. Of the total value of the 1903 production, the sum of $33,970 is due to pulpstones, an increase of $10,882 as compared with the value ($23,088) of the 1902 production, and this in turn was an increase of $4,288 over the 1901 value of

$18,800. The sum of $687,476 due to grindstones is an increase of $43,133 as compared with $644,343, the value of the 1902 production, which was an increase of $82,440 over the value of the 1901 production of $561,903. In the following table is given the value of the production of grindstones and pulpstones for the years 1901 to 1903:

Value of the production of grindstones and pulpstones, 1901–1903.

	1901.	1902.	1903.
Grindstones	$561,903	$644,343	$687,476
Pulpstones	18,800	23,088	33,970
Total	580,703	667,431	721,446

Since 1898 there has been a decided increase in the production of grindstones, which is due very largely to the marked increase during this same period of all kinds of manufacturing industries, nearly all of which use some variety of grindstone. There has also been an increase in the production of pulpstones, which, although not large in itself, causes a large gain in percentage.

Some of the producers in making their reports to the Survey use the ton as the unit of measurement, while others give the actual number of grindstones made. In 1903 the number of grindstones reported, exclusive of pulpstones, aggregated 52,383 pieces, valued at $501,500, as compared with 29,543 pieces, valued at $100,875, in 1902. The product reported by weight amounted to 16,891 tons, valued at $185,976, as compared with 44,268 tons, valued at $538,713, in 1902. The average value of that portion of the 1903 product reported by weight was $11 per ton. The price per ton reported varied from $6 to $26, the latter figure being for the Montana production, which was sold locally. The weight of the pulpstones produced in 1903 was 414 tons, valued at $33,970, or an average of $82.05 per ton, the value varying from $30 to $100 per ton.

There is given in the following tables the value of the grindstones and pulpstones produced in the United States during 1903 and 1902, by States:

Value of grindstones and pulpstones produced in the United States during 1903, by States.

State.	1903.
Ohio	$646,776
Michigan	70,550
West Virginia, Missouri, and Montana	4,120
Total	721,446

Value of grindstones and pulpstones produced in the United States during 1902, by States.

State.	1902.
Ohio	$560,412
Michigan, Montana, and Wyoming	[a] 84,672
West Virginia	22,347
Total	667,431

[a] The greater part of the value of this production was from Michigan.

As is seen from these tables, there was an increase of $86,364 in the value of the Ohio production in 1903 over that of 1902, while there was a large falling off in the value of the West Virginia production. The production for Michigan was about the same in both 1902 and 1903. Wyoming, which had a small production in 1902, did not report any in 1903, while Missouri was added to the list of producers in 1903, making the number of States producing grindstones in 1903 the same as in 1902. There was a total of 21 producers of grindstones in 1903, of whom 14 were in Ohio, 4 in Michigan, and 1 each in Missouri, Montana, and West Virginia.

The following table shows the value of the production of grindstones and pulpstones from 1880 to 1903, inclusive. This table illustrates very clearly the depression and revival of this industry, and therefore of the manufacturing industries of the country, during and since the financial depression of 1893 and the years immediately following.

Value of grindstones produced in the United States, 1880–1903.

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	1903	721,446

IMPORTS.

The grindstones that are imported into the United States are principally pulpstones and grindstones for use in the glass and the optical trades. These are obtained from Newcastle-upon-Tyne, England, and from Wales, Scotland, and Bavaria; and in 1903 their value amounted to $85,705, as compared with $76,906, the value of those imported in

1902. With the increase in the production of pulpstones from Ohio and the introduction of the West Virginia stone on the market for use in the glass and the optical trades, it would seem that there should be a greater decrease in the imports than has taken place during the last three or four years. The Bureau of Statistics of the Department of Commerce and Labor, in reporting the imports of grindstones, has not made any separation of the quantity of the finished and of the unfinished products since 1883.

In the table below are given the quantity and the value of the grindstones imported into the United States from 1868 to 1885, inclusive, and of the value since 1886.

Grindstones imported and entered for consumption in the United States, 1868-1903.

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 [illegible]
1885	....	....	....	....	50,579
December 31—					
1886	....	....	....	....	39,119
1887	....	....	....	....	[illegible]
1888	....	....	....	....	[illegible]
1889	....	....	....	....	57,720
1890	....	....	....	....	[illegible]
1891	....	....	....	....	[illegible]
1892	....	....	....	....	[illegible]
1893	....	....	....	....	[illegible]
1894	....	....	....	....	[illegible]
1895	....	....	....	....	[illegible]
1896	....	....	....	....	[illegible]
1897	....	....	....	....	49,196
1898	....	....	....	....	[illegible]
1899	....	....	....	....	[illegible]
1900	....	....	....	....	[illegible]
1901	....	....	....	....	[illegible]
1902	....	....	....	....	[illegible]
1903	....	....	....	....	[illegible]

a Since 1883 not separately classified.

CANADIAN PRODUCTION.

The production of grindstones in Canada has not yet become very large, and in 1903 there were produced only 5,538 tons in quantity, valued at $48,302, or $8.72 per ton. This value per ton is somewhat lower than the average price of $11 per ton received for the United States production.

BUHRSTONES AND MILLSTONES.

PRODUCTION.

The value of the production of buhrstones in 1903 was $52,552, a decrease of $7,256 as compared with $59,808, the value of the production in 1902. For the last three years the value of the production has been over $50,000, and it is very probable that the production will continue for some time to come to increase gradually in value. From 1880 to 1887 the value of the production ranged between $100,000 and $200,000, but from 1887 to 1894 there was a large decrease, from $100,000 to $13,887, due to the introduction of the roller-mill process in grinding wheat, which superseded the use of buhrstones, except in a few local areas. Since 1894, however, there has been a gradual increase in the production on account of the use of these stones for grinding the coarser cereals, mineral paint ores, fertilizers, cement rock, barytes, quartz, and other minerals. For these uses the demand is increasing each year.

There were 5 States from which the production of 1903 was obtained, with a total of 26 producers, as follows: New York, 17; Pennsylvania and Virginia, 3 each; North Carolina, 2, and Vermont, 1. These were the same States from which the production of 1902 was obtained. The following table gives the value of the production in 1902 and 1903 by States:

Value of buhrstones produced in the United States in 1902 and 1903, by States.

State.	1902.	1903.
New York	$39,570	$35,441
Virginia	11,435	9,812
North Carolina and Vermont	6,825	5,902
Pennsylvania	1,978	1,397
Total	59,808	52,552

As is shown by this table, the decrease in the value of the production of buhrstones in 1903 as compared with 1902 is nearly uniformly divided among all the States.

The value of buhrstones produced in the United States since 1880 is given in the following table:

Value of buhrstones produced in the United States, 1880–1903.

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	32,856
1889	35,155	1901	57,179
1890	23,720	1902	59,808
1891	16,587	1903	52,552

IMPORTS.

There is considerable variation in the value of the imports of buhrstones into the United States, as is shown in the following table, which gives the value of the buhrstones imported since 1868.

Value of buhrstones and millstones imported into the United States, 1868–1903.

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	40,855	1,302	42,157
1884	45,837	263	46,100	1902	15,243	915	16,158
1885	35,022	455	35,477	1903	21,160	8,481	29,641

a Not separately classified.

PUMICE.

The name pumice is applied to the loose, spongy, cellular, or froth-like parts of lava, and also to a volcanic ash, which includes the finer detritus that is ejected in many eruptions, and is often deposited at considerable distances. For commercial pumice both the solid rock and the volcanic ash are mined. Extensive deposits of volcanic ash are known in Nebraska, which are available as a source of pumice. In the Hawaiian Islands also there are large quantities of pumice, which could readily supply the demand of this country if it could compete with the imported material.

Pumice stone varies considerably in grain and hardness, and this fact has led to experiments being carried on with a view to producing an artificial pumice stone. Such a product is now manufactured quite extensively by a German company, as described by Mr. O. J. D. Hughes, consul-general at Coburg, as follows:[a]

The factory of Schumacher, at Bietigheim, in the valley of the Enz, has been manufacturing an artificial pumice stone out of ground sandstone and clay for some time, and it is interesting to note to what extent this manufacturer has tried to adapt his products to the various purposes for which they are required. There are on the whole 10 kinds, differing from each other in regard to hardness and grain, viz: There is (1) a hard and a soft kind with coarse grain, particularly useful in the leather, wax-cloth, felt, and wood industries; (2) a hard and a soft kind with medium coarse grain, suited to stucco workers and sculptors, and particularly useful for polishing wood before it is painted; (3) a soft, fine-grained stone for the white and dry polish of wood and for tin goods; (4) one of medium hardness with fine grain for giving the wood a surface for an oil polish; (5) a hard, fine-grained one for working metals and stones, especially lithographic stones; and, finally, pumice stones with a very fine grain. These artificial stones are used in pretty much the same way as those of volcanic origin. For giving a smooth surface to wood a dry stone is applied, but to give it a fine polish the stone is dipped in oil. For fine work no coarse-grained and for coarse work no fine-grained stones are used.

Nearly all the world's demand for pumice is supplied by a deposit in the northwestern part of the island of Lipari, and about 80 per cent of that used in the United States is shipped directly here from that island. There have been numerous attempts made during the last twenty years by various firms to obtain control of the Lipari pumice deposits, but without success. In 1903 a German company made a determined effort to realize this aim, and according to the Oil, Paint and Drug Reporter of December 21, 1903—

The agents of the German promoters at Lipari, according to the latest authentic private reports, have succeeded in closing contracts for pumice stone with all the producers except one or two. All but 45 per cent of the entire territory, of which only a small part has never been worked, belongs to the town of Lipari. Efforts have been made to get the municipality of Lipari to join the combination, but up to the present these treaties have not come to a satisfactory close because the municipal

[a] Consular Reports, No. 275, August, 1903.

council of Lipari was dissolved in September last. The affairs of the municipality are at present directed by a government deputy, who, however, is not empowered to make contracts of such importance in the name of the island.

If such a merger should be effected there would be a sharp advance in prices, which would tend to stimulate the development of the American and Hawaiian deposits.

PRODUCTION.

The entire production of pumice in the United States in 1903 was from Nebraska, and amounted to 885 tons, valued at $2,665, or $3.02 per ton. This is an increase of 185 tons in quantity, but a decrease of $85 in value, as compared with the production of 1902, which amounted to 700 tons, valued at $2,750, or $3.93 per ton. Nearly all of the production was used in the manufacture of soap. There were four producers engaged in the production of pumice in 1903. A little development work was carried on by Mr. C. A. Warner, at Rockland, Oneida County, Idaho, but there was no production during 1903.

IMPORTS.

The importation of pumice into the United States is very irregular, some years there being enough imported nearly to satisfy the market for the following year. In 1896 there was no pumice imported. In 1903 the value of the imports of pumice was $83,920, as compared with $22,448 in 1902.

INFUSORIAL EARTH AND TRIPOLI.

The terms infusorial earth, tripoli, and diatomaceous earth are all applied to the deposits formed from the siliceous shells of diatoms and other microscopic species, which sometimes occur over many miles in area. The material from such deposits will always show remains of diatoms or other similar species when examined under the microscope, and is composed principally of silica, with perhaps from 3 or 4 to 10 or more per cent of water or moisture. Sometimes the deposits are impure from the admixture of clay, and then again they may be discolored by organic material. This, however, can very often be entirely removed by heating. There are on the market other materials besides that obtained from these deposits which are sold under the same name. Thus in New York and Connecticut there is ground quartz used for infusorial earth, and in Newton County, Mo., the material mined is evidently a residual silica left from an impure siliceous limestone by the leaching out of the calcium carbonate. These materials do not make so smooth and even a grit for the manufacture of scouring and polishing powders as the real infusorial earth.

Only a portion of the infusorial earth is used for abrasive purposes, the more extensive use being in the manufacture of dynamite and of packing for boilers, steam pipes, and safes, and as a base for fire and heat-retarding cements. It is also used in some quantity for the manufacture of fireproof building materials, such as solid and hollow brick and tile. For this latter use the demand is constantly increasing. Another use that is being introduced is in the manufacture of plasters. The ground quartz, sold under the name of infusorial earth, is all used for abrasive purposes. The Missouri product is principally used in the manufacture of various filtering apparatus.

PRODUCTION.

There was a considerable increase in the production of infusorial earth in 1903, which amounted to 9,219 short tons, valued at $76,273, a gain of 3,554 tons in quantity and of $23,029 in value, as compared with the production of 5,665 short tons, valued at $53,244 in 1902. Of the 1903 production, 1,914 short tons, valued at $6,632, was sold in the crude state, and 7,305 short tons, valued at $69,641, was subjected to some refining or cleaning process before being marketed. In the case of the Missouri product the value of the manufactured articles is used.

The States from which this production was obtained, given in the order of their production, and the number of producers in each were as follows: Missouri, 3; Virginia, 2; New York, 2; California, 3; Maryland, 1; Georgia, 1; Massachusetts, 1; New Hampshire, 1; and Florida, 1—a total of 15 producers in 10 States.

There is considerable variation in the quantity and value of the 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. This variation is shown in the following table, which gives the quantity and value of infusorial earth produced in the United States since 1880:

Production of infusorial earth, 1880–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	1,833	$45,660	1892	....	$43,665
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	1903	9,219	76,273

IMPORTS.

The infusorial earth or tripoli imported into the United States is included with rotten stone, which is used for similar purposes. The value of these imports in 1903 was $34,987 as compared with $39,926 in 1902. The Bureau of Statistics does not keep any record of the number of tons of this material imported.

CRYSTALLINE QUARTZ.

Under the head of crystalline quartz is included only that portion of the total quantity of this mineral that is actually used for abrasive purposes. The larger amount of the quartz mined is used in the brick and pottery, building, and glass industries, and as a flux in metallurgical works. That which is included under abrasives is used in the manufacture of sandpaper, scouring soaps, and as a wood finisher. Nearly all of the quartz used in the manufacture of a wood finisher is obtained from Connecticut, while the greater part of that used in the manufacture of sandpaper is obtained from Pennsylvania. There are also large quantities of quartz sand used in the stonecutting trades, especially by the marble dealers, for cutting the blocks of stone into slabs by means of a gang saw. Crushed steel, also, although much more expensive, is beginning to be used to a considerable extent for this purpose. Considerable quartz sand is also used in the manufacture of oilstones, scythestones, etc., in reducing the rough blocks of sandstone and schist to the correct size and shape on the rubbing table. As the users of quartz sand for these latter purposes keep little or no record of the quantity they use or of its value, there has been no attempt made to include them in this report. In many instances the only cost of the sand to the consumer is that of cartage, while in other cases it costs from 10 cents to $1 per ton.

PRODUCTION.

The production of crystalline quartz in the United States in 1903 amounted to 8,938 short tons, valued at $76,908, as compared with 13,904 tons, valued at $84,335, in 1902, a decrease of 4,966 short tons in quantity and of $7,427 in value. Of the 1903 production the quantity reported as sold in the rough was 918 short tons, valued at $5,318, or $5.79 per ton. The refined product amounted to 8,020 short tons in quantity, valued at $71,590; or $8.93 per ton. This production was obtained from California, Connecticut, and Pennsylvania, with the larger amount from Connecticut.

In the following table are given the quantity and value of crystalline quartz produced in the United States since 1894:

Production of crystalline quartz, 1894–1903.

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	1903	8,938	76,908

GARNET.

The principal change in the garnet industry is the development of a new locality for this mineral in North Carolina and its introduction on the market early in 1904. The deposit is located near Marshall, Madison County, on Little Pine Creek. The garnet crystals, which are of the almandine variety, occur in a band of chloritic schist about 20 feet wide, that can be traced across country for a distance of about 1 mile. The noticeable feature of this deposit is the remarkable size of the crystals, which average at least 2 inches in diameter, some having been found 7½ inches in diameter. The crystals, though usually elongated, are well developed and dodecahedral in character. They are usually slightly altered on the exterior surfaces to chlorite, but on the interior they are sound and break with a clean, sharp, cutting edge. They are readily separated from the inclosing rock, and a pure garnet product is easily obtained. None of this garnet was mined in 1903; but mining operations were begun early in 1904, and the product already shipped has been received very favorably. On account both of the ease with which this garnet can be mined and separated and of its quality, it should readily be able to compete with any other garnet. The property is well located for railroad transportation facilities, being on the main western line of the Southern Railway, running from Salisbury, N. C., to Chattanooga, Tenn.

There were no other new localities developed in 1903, and the production was confined to the old deposits in Connecticut, New York, Pennsylvania, and North Carolina.

PRODUCTION.

During 1903 there were produced in the United States 3,950 short tons of garnet, valued at $132,500. This is very close to the 1902 production of 3,926 short tons, valued at $132,820, being an increase of 24 tons in quantity, but a decrease of $320 in value. The average price of the 1903 production was $33.54 per ton. The highest price received for garnet is still for the North Carolina garnet.

There are given in the following table the quantity and value of the garnet produced in the United States since 1894:

Production of abrasive garnet, 1894–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1894	2,401	$90,660	1899	2,765	$96,325
1895	8,825	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	1903	3,950	132,500

Previous to 1900 there was a certain quantity of the North Carolina production that was not included in the garnet statistics, and this will account to some extent for the decided increase in the production since that year. In reality there has been a close agreement between the quantities of garnet produced from year to year.

CORUNDUM AND EMERY.

Whereas formerly the United States produced all the corundum used in this country, now but a small portion is mined here, the remainder being obtained from Canada and India. There was considerable development work carried on at both the Montana and the North Carolina corundum deposits in 1903, although the production from the latter State amounted to but a very few tons. The Montana Corundum Company, whose property is near Salesville, Mont., and the North Carolina Corundum Company, whose property is at Buck Creek, Clay County, N. C., have both completed mills for cleaning the corundum, and they expect to be large producers of this abrasive in 1904. Mr. Hugh Ferguson, of Pittsburg, Pa., has also been developing a corundum deposit in the Buck Creek district, North Carolina.

In Buncombe County, N. C., on the Elk Mountain range, a few miles north of Asheville, corundum has been found associated with garnet, sometimes being entirely inclosed by the garnet and at others inclosing the garnet. The corundum occurs in a garnetiferous gneiss, and although it is somewhat abundant it is very doubtful if it will prove to be a commercial source of corundum. As described by Mr. C. E. Lyman, of Asheville, the corundum is found sometimes in crystals that measure as much as an inch in diameter. They are prismatic and are terminated by the basal plane. They vary considerably in color, from blue to red, and a few gems have been cut from some of them. The corundum is found in the gneiss near its contact with a pegmatitic dike.

Near Norris, Madison County, Mont., Mr. A. W. Tanner reports the finding of considerable corundum of gem quality in his concentrates from gold placer mining. One piece of corundum showing good red and green colors, weighed 8 ounces, and one piece of ruby corundum weighed 588½ carats.

Mr. F. A. Maxwell, of Georgetown, Clear Creek County, Colo., reports the finding of corundum on Saxen Mountain, near that place.

PRODUCTION.

There was a very large decrease in the production of corundum and emery in the United States in 1903, which amounted to only 2,542 short tons, valued at $64,102. This is a decrease of 1,709 tons in quantity and of $40,503 in value as compared with the production of 4,251 tons, valued at $104,605, in 1902. A small portion of this production was due to corundum which was obtained principally from Montana, with a smaller amount from North Carolina. The emery was obtained principally from New York and Massachusetts, with a small amount reported from Kansas. This year the production of the Peekskill, N. Y., deposits largely exceeded that of the Chester, Mass., deposits, which formerly were the largest producers of emery.

The total quantity and value of the corundum and emery produced in the United States since 1880 is given in the following table:

Annual production of corundum and emery, 1881–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1881	500	$80,000	1893	1,713	$142,325
1882	500	80,000	1894	1,495	95,936
1883	550	100,000	1895	2,102	106,256
1884	600	108,000	1896	2,120	113,246
1885	600	108,000	1897	2,165	106,574
1886	645	116,190	1898	4,064	275,064
1887	600	108,000	1899	4,900	150,600
1888	589	91,620	1900	4,305	102,715
1889	2,245	105,567	1901	4,305	146,040
1890	1,970	89,395	1902	4,251	104,605
1891	2,247	90,230	1903	2,542	64,102
1892	1,771	181,300			

IMPORTS.

The imports of emery and corundum continue to be largely in excess of the home production, and in 1903 they were valued at $321,569, as compared with $214,842, the value of the 1902 imports. There continued to be an increase of corundum imported, particularly from the Canadian deposits. The following table shows the quantity and value of emery and corundum imported into the United States from 1867 to 1903, inclusive:

Emery and corundum imported into the United States, 1867–1903.

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	924,431	$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	61,658
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	194,314	8,789	757	74,800
December 31—								
1886	161,297	6,910	3,782	88,925	365,947	24,952	851	121,688
1887	367,239	14,290	2,078	45,033	a144,380	6,796	2,090	68,309
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	6,803	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	....	....	2,221	130,581
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
1903	3,615,137	109,272	10,884	b194,468	....	....	17,829	321,569

a To June 30 only; since classed with grains. b Including emery rock valued at $5,488.

CANADIAN CORUNDUM.

The deposits of corundum in Canada are being very extensively worked and there are now three companies in the field as producers of this mineral: (1) The Canada Corundum Company, which is by far the largest producer, and whose principal deposits are located near Craigmont, 8 miles from Combermere, Renfrew County. This company has recently completed its new mill for crushing, cleaning, and sizing the corundum, which has a capacity of about 5,000 tons of cleaned corundum per year. (2) The Ontario Corundum Company, whose mine is situated at New Carlo, Ontario, about 12 miles from Craigmont. This company formerly shipped its partly cleaned corundum ore to Chester, Mass., but it has now erected a mill with a capacity of about 4 tons of cleaned corundum per day. (3) The Corundum Refiners (Limited), who own corundum deposits on Madawaska River, near Palmer Rapids, Renfrew County, and on York River, in Durgaman Township, near Bancroft, Hastings County, expect to put up a large cleaning mill and to begin shipping corundum about September 1, 1904.

The price of the Canadian corundum varies from 5 to 7½ cents per pound delivered at the railroad. At the present time the value of the production of the Canada Corundum Company is the largest of any corundum or emery producer in America.

In 1903 the total value of the Canadian production of corundum was $87,600, which, as stated in the report of the geological survey of Canada, is divided as follows: Corundum, grain, 849 short tons, valued at $84,900; and corundum, cobbed, 270 short tons, valued at $2,700. This latter quantity will contain probably 25 per cent of corundum, or 67 tons, which, at an average value of $120 per ton, would make the real total production of Canadian corundum equal to 916 short tons, valued at $92,940. This is an increase of 111 short tons in quantity and of $4,324 in value, as compared with the production of 805 tons, valued at $88,616, in 1902. One-half of this production is shipped to the United States.

The increasing demand for the Canadian corundum is illustrated by the following table, which gives the production for the years 1901, 1902, and 1903:

Production of Canadian corundum in 1901, 1902, and 1903.

Year.	Quantity.	Value.
	Short tons.	
1901	434	$47,740
1902	805	88,616
1903	916	92,940

With the increased facilities for handling and cleaning the corundum ore there should be a much larger increase in the Canadian production in 1904.

FELDSPAR.

Several years ago a deposit of mineral supposed to be corundum was located on the north shore of Lake Superior in Minnesota, and a company known as the Minnesota Abrasive Company was organized to exploit and develop the property. Upon examination the mineral proved to be a plagioclase feldspar instead of corundum. Its value as an abrasive is problematic on account of its low degree of hardness and its fusibility. It could not be used in the manufacture of a vitrified wheel. There are two companies, however, who are preparing to mine this feldspar and prepare it for the market, the North Shore Abrasive Company and the Minnesota Abrasive Company. For some purposes this mineral may give good satisfaction as an abrasive, but there will probably be a very limited demand for it.

ARTIFICIAL ABRASIVES.

CARBORUNDUM.

An interesting paper has recently been published by Mr. F. A. J. Fitzgerald, of Niagara Falls, N. Y.,[a] on the "Manufacture and Uses of Carborundum," and that portion of the article relating to the present method of manufacture is given as follows:

In the actual manufacture of carborundum the silica is supplied by means of a very pure glass sand made from crushed quartz and containing about 99.5 per cent silica. The carbon is supplied by coke, which is as pure as can be obtained. It has just been shown that for every 10 pounds of carborundum produced 14 pounds of carbon monoxide gas are set free, so that the mixture of sand and coke must be very porous in order to permit the ready escape of the gas. This porosity is obtained by putting a certain amount of sawdust in the mixture of sand and coke.

The various materials used in the manufacture of carborundum are received in the mixing building. The sand is shipped in the ground form, so that it merely has to be stored in the bins; but the coke has to be crushed and ground to powder in a mill, whence it is taken by conveyors to its bin. The coke, sand, and sawdust are then mixed in proper proportions and the mixture is stored in bins provided for that purpose. From these bins the mixture can readily be drawn off and taken to the furnace building. The latter contains three sets of furnaces, each set consisting of five furnaces. These have the form of a box built of brick, the inside dimensions being approximately: Length, 16 feet; width, 7 feet; and depth, 6 feet.

The ends of the furnaces are permanent and carry the terminals, which consist of large carbon rods and are so arranged that they may be connected to the cables carrying the current. The side walls of the furnace are not permanent, but are built up every time the furnace is loaded. In preparing a furnace for a run, the side walls are first built up, and then the furnace is filled rather more than half full with the mixture of sand, coke, and sawdust. The next stage, the most important in the building of the furnace, is putting the core in place. The core is an electrical conductor composed of carbon, which serves to connect the terminals of the furnace electrically. After the core has been put in place more mixture is thrown into the

[a] Iron Age, Oct. 15, 1903.

furnace and heaped up until the total height of the loaded furnace is about 10 feet. Nothing now remains but to connect the furnace with the source of the current.

Next to the furnace building is the transformer room, where the current from the power house comes in at 2,200 volts and is transformed to 150 volts. Beside each transformer is an induction regulator, which consists essentially of two coils which can be moved relatively to one another; one of the coils is connected in series, the other in parallel with the circuit going to the furnace room. By adjusting the relative positions of the coils of the regulator the voltage of the current going to the furnace room can be either raised or lowered uniformly, with a maximum of about 210 and a minimum of 80 volts. The reason for having this range of voltage is that the resistance of the core, which is the part of the furnace that carries the current, is at first high but diminishes when it becomes hot, and also for another reason which we shall see when we come to consider the products of the furnace.

One furnace, such as has been described, requires 1,000 horsepower. After it has been connected with the cables in the furnace room the current is thrown on in the transformer room, and the voltage put up to the maximum. In a very short time the furnace comes to load; that is to say, the resistance of the core drops until the current reaches about 3,500 amperes, and the total watts amount to 746,000, or 1,000 horsepower. As the resistance continues to decrease the core takes a larger current, and consequently the volts must be cut down so as to keep the power constant. Finally the resistance becomes nearly constant, when the amperes are about 7,500, and hence the voltage is about 100. The total run lasts thirty-six hours.

About half an hour after the current is thrown on a light is applied to the side walls of the furnace, and the carbon monoxide, which by this time is coming off rapidly, ignites with a slight explosion. As the furnace becomes hotter the development of carbon monoxide gas increases till the whole furnace is enveloped in blue flames, presenting a very beautiful appearance.

One of these carborundum furnaces yields about 8,500 pounds of silicon carbide, so that from the equation already given it is easily calculated that about 6 tons of carbon monoxide are generated during the run. At first sight it seems wasteful that all this gas should escape and be burned at the walls of the furnace; but it probably is of value in keeping the walls of the furnace hot and so diminishing the radiation of heat from the inside of the furnace.

After thirty-six hours the current is cut off from the furnace and another one connected. For each 1,000 horsepower used there are 5 furnaces, so that there are 15 furnaces in all for the 3,000 horsepower used by the Carborundum Company. Each 1,000 horsepower produces approximately 4,800 pounds of crystalline carborundum per day, so that the present output amounts to about 7 tons a day. The company are at present building a new furnace plant at Niagara Falls, and when this is finished the total power used will be 5,000 horsepower, which will give an output of about 11.7 tons a day. In the new furnace room there will be a 2,000-horsepower furnace, probably the largest electric furnace in the world.

Immediately after the current has been cut off from the furnace the taking down of the side walls is begun, so as to cool the furnace as rapidly as possible. After half the wall is taken down the unchanged mixture is raked off, and the outer crust of partially converted material is removed. This crust which surrounds the carborundum crystals is known as "white stuff," and is an intermediate stage in the formation of carborundum. When the "white stuff" has been removed the crystalline carborundum is exposed and is taken from the furnace to the crushing room. When the core is removed from the furnace it is found to be converted into graphite, and this is the principal cause of the great reduction in the resistance of the furnace during the run.

After the carborundum is removed from the furnace it is taken to pan mills, where it is crushed and is then placed in large lead-lined tanks and digested with a hot and strong solution of sulphuric acid, after which it is thoroughly washed with water, dried, and graded. In washing with water the fine powders are floated off and subsequently collected in settling tanks.

The equation representing the reaction thus described is as follows:

$$\underset{\text{Sand}}{SiO_2} + \underset{\text{Coke}}{3C} = \underset{\text{Carborundum}}{CSi} + \underset{\text{Carbon monoxide gas.}}{2CO}$$

There are of course some impurities in the materials used, but they are very nearly pure, as is indicated by the following typical analysis of the carborundum made by the present method. For comparison there is given the theoretical composition of carborundum.

Analysis of carborundum.

Constituent.	Carborundum.	Theoretical composition.
	Per cent.	*Per cent.*
Silicon, Si	69.61	70.30
Carbon, C	29.40	29.70
Iron, Fe	.15	
Aluminum, Al	.59	

When carborundum was first manufactured it was put on the market solely for abrasive purposes in the form of wheels and stones of various shapes and sizes, or as paper and cloth and as grains, and while the largest use of this material is still for such purposes, some is now being used in the manufacture of steel and for refractory purposes.

Amorphous carborundum, under the trade name of carborundum fire sand, is being widely used as a furnace lining in brass-melting furnaces, both in the form of brick and as mortar. Crystalline carborundum in the form of a fine powder is being applied as a wash or a coating to the faces of fire-brick walls, being mixed with a solution of silicate soda. Under the action of flames this coating forms a firm enamel which greatly increases its resistance power to heat.[a]

The Carborundum Company are still the only manufacturers of carborundum wheels and stones and are now making solid wheels 36 inches in diameter by 12 inches thick. They make a sectional wheel 12 feet in diameter, used for grinding soapstone.

PRODUCTION.

The production of carborundum in 1903 amounted to 4,759,890 pounds, an increase of 1,018,390 pounds as compared with the production of 3,741,500 pounds in 1902. This is the largest production in any year since the beginning of the manufacture of this abrasive. The increase in the demand for carborundum is well brought out in the following table, which gives its production since 1892, when it was

[a] Letter from the Carborundum Company.

first put on the market. Its value now varies from 8 to 10 cents per pound.

Production of carborundum, 1892–1903.

Year.	Quantity.	Year.	Quantity.
	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	1903	4,759,890

CRUSHED STEEL.

The use of particles of steel for abrasive purposes was first introduced about fifty years ago in certain German industries, where the steel used was broken pieces of old files. This same idea of utilizing pieces of broken-up files was attempted later in this country by Mr. C. M. Lindsey as a substitute for sand in cutting marble and other stones. The results were not satisfactory, owing to the impossibility of obtaining a uniform product. These experiments did, however, result beneficially, as they proved the value of hardened pieces of steel for abrasive purposes and led finally to the discovery of crushed steel, which was patented by Mr. Lindsey.

Sand was formerly the principal material used for cutting stone, but this was later partly superseded by a hardened steel known as chilled iron globules or chilled shot. This material in many cases gave much better satisfaction than sand, and although it was a much more expensive raw material, it made a cheaper abrasive on account of its greater cutting capacity. Owing, however, to its rounded character, it did not give perfect satisfaction, and it has in turn been superseded by diamond crushed steel, which has sharper and more angular edges. Although the crushed steel is more expensive than chilled shot, its superior abrasive efficiency makes it in many cases the cheaper abrasive. The manufacturing of crushed steel has been so perfected that an absolutely uniform material can be produced. The method of manufacture and uses of crushed steel have recently been described by Mr. M. M. Kann,[a] secretary of the Pittsburg Crushed Steel Company (Limited.)

In manufacturing these crushed steel abrasives the best material to use is high-grade crucible steel. This is heated to a temperature of about 2,500° F. (nearly a white heat) and then quenched in a bath of cold water. This gives the steel a granular structure. These fragments of steel are then reduced to particles, varying in size from fine

[a] Proc. Am. Asso. Adv. Sci., Pittsburg meeting, July, 1903.

powder to one-sixth of an inch in diameter, by means of powerful hammers or crushing machines. The crushed product is then classified into sizes varying from No. 6 to No. 200 mesh. The sizes from 6 to 60 are then tempered by being placed in a cylinder or pan and heated to a temperature of about 450° F., when they change in appearance to a straw color. They are then cooled by subjecting them to blasts of cold air. This material is known as diamond crushed steel. The sizes from 60 to 200 are treated similarly, but are hardened still more. These latter sizes are known as diamond steel emery.

USES.

The uses of the different kinds of crushed steel have greatly increased since their first introduction to the market. They are now used in sawing, rubbing, and polishing marble, onyx, granite, and other stones, in grinding lenses, in beveling glass, in grinding brick, and in grinding valves. They are also used by lithographers and plate-glass manufacturers.

The chief use, however, of crushed steel is still the stone trade. The sizes of crushed steel used depend on the character of the stone to be cut, rubbed, or polished. In cutting a coarse brown sandstone, like the noted Connecticut stone, the largest sizes of crushed steel, 10 to 16, are used. For a stone of finer texture, like the Indiana limestone, sizes 30 to 36 are used, and for stones like marble and onyx the still finer sizes, 46 to 50, are used.

In rubbing down granite the size of crushed steel to use will depend upon the condition of the surface of the stone as it comes from the cutter, whether it comes from the pointing tool, from the ax, or from the 4, 6, or 8 hammer. The finer the surface left by the stonecutter, the smaller the sizes of crushed steel that should be used. In rubbing stone, beveling glass, and grinding brick revolving iron wheels are used, which vary in size according to the work to be done. For rubbing stone, wheels 12 to 13 feet in diameter are used; for grinding brick, wheels 6 to 7 feet in diameter are used, and for beveling glass, wheels 30 inches in diameter are used. The crushed steel is used over and over again, being re-fed automatically to the table.

In lens grinding steel emery in sizes varying from 70 to 90 is used for roughing in and No. 170 for fining down. In the lithographic trade steel emery in sizes 150, 160, and 170 is used.

Another use of crushed steel is in core drilling. Where it has been used for this purpose it has given good results. Mr. Kann mentions two cores that have been cut by drills using crushed steel. One was a 65-foot core, 1½ inches in diameter, taken from the Lake Superior sandstone. The steel used was No. 14. The other core was 130 feet long and 6 inches in diameter, and was taken from the Cleveland sandstone.

Crushed steel oxidizes quite readily, but this can be prevented by adding a small quantity of quicklime to the grains of steel; this has been done to advantage in the marble-cutting establishments.

During the last eight months an automatic feeding machine has been devised, which has led to a much greater use of crushed steel among the glass bevelers.

No satisfactory method has thus far been devised for making wheels out of crushed steel. If this could be accomplished it would undoubtedly increase the use of this abrasive.

PRODUCTION.

In 1903 the production of crushed steel amounted to 755,000 pounds, which is the greatest production of any year since this abrasive was put on the market. The average value per pound was 7 cents. The prices of the different grades of crushed steel vary from 5½ to 10 cents per pound.

The following table shows the quantity of crushed steel produced each year since 1898:

Production of crushed steel in the United States, 1898–1903.

Year.	Quantity.	Year.	Quantity.
	Pounds.		*Pounds.*
1898	660,000	1901	690,000
1899	675,000	1902	735,000
1900	700,000	1903	755,000

ARTIFICIAL CORUNDUM.

The manufacture of artificial corundum from bauxite was carried on by the Norton Emery Wheel Company at its plant at Niagara Falls much more extensively in 1903 than in 1902, and its production as an abrasive material is now assured. It makes a clean, fast-cutting abrasive, and is now put on the market in the form of wheels and stones by the Norton Emery Wheel Company. None of the grain has as yet been put on the market.

ADAMITE.

This artificial abrasive is at the present time manufactured in Germany, the raw material being shipped to this country, where it is crushed and graded by the Adamite Abrasive Company. The quantity of this abrasive that is used is not large.

BORAX.

By Charles G. Yale.

INTRODUCTION.

The borax fields of the United States are mainly located in the desert regions of southeastern California, in western Nevada, and in Oregon. Almost the entire production comes, however, from California. The Nevada fields are in reality in the northern extension of the California deposits, the drainage of the "Great Basin" being toward its greatest depression in the south, known as Death Valley. It is apparent that California contains in her desert "dry lake" region the main source of supply of borax in the United States.

Borax ores, commonly called borate of lime, are found in the following known places: At Chetco, Curry County, Oreg., as borate of lime and known as priceite. This deposit is not being operated at present and is controlled by the Borax Consolidated (Limited). The ore is considered very rich in boric acid contents, but it is found in pockets only, embedded in a serpentine formation, which makes the mining very costly. Furthermore, being over 100 miles from railroad transportation facilities, the hauling is very expensive. Although the deposit lies at the foot of the mountains which overlook the Pacific Ocean, there is no harbor near by at which vessels may dock, and the ocean at this point is, as a rule, quite rough. The property has been closed down for several years, as the company owning it has other deposits more advantageous to operate.

A borate of soda is found in Harney County, Oreg., about 130 miles north of Winnemucca, Nev., to which place the small product is shipped by mule teams. The Rose Valley Borax Company owns the best portion of the marsh lands where the deposits are found. The mines are temporarily idle and no product was obtained in 1903.

The various marshes throughout western Nevada and southeastern California are not being operated to any extent, as the price of borax as now sold will not permit the profitable operation of most of them.

The mines of California now being worked are referred to more fully hereafter.

The first borax produced in the United States was in 1864 at Borax Lake on the margin of Clear Lake, Lake County, Cal., where 12 short tons were manufactured by the evaporation of the waters of the lake. The price obtained at that time was 39 cents per pound, or $780 per ton. Before this production, however, Dr. John A. Veatch had discovered borax (in 1856) at the Tuscan Springs in Tehama County, and also at the mouth of Pitt River, Shasta County, Cal. In that same year he discovered the existence of borax at Borax Lake, where the first production was subsequently made. In 1860 the same gentleman found traces of borax at Mono Lake, Mono County. In 1863 J. W. Searles discovered borax in Searles Lake, in San Bernardino County, near the Inyo County line. From 1864 to 1868 the entire product of the United States came from the waters of Borax Lake, Lake County. An artesian well finally diluted the waters so that the work became unprofitable. In 1872 a small quantity came from lake Hachinhama, on the opposite side of Clear Lake. The next step in the progress of the industry was the working of the saline crusts on the so-called Dry Lakes or Borax Marshes of the Mohave Desert in 1873. San Bernardino and Inyo counties each began to have an output about that time. About 1887 operations were suspended in most of the marsh beds, and not long after work was begun on the colemanite or borate of lime bed in San Bernardino County, from which source most of the borax of the United States has since been derived. The saline deposits of California have been very fully described by Mr. Gilbert E. Bailey, of the California State Mining Bureau, and more briefly by Mr. M. R. Campbell, of the United States Geological Survey.[a]

PRODUCTION.

The colemanite deposits of San Bernardino County, Cal., continue to form the main source of supply of borax of the United States, though to a small extent there is a production from the marsh deposits of California, Nevada, and Oregon. The returns give an aggregate production of crude borax amounting to 34,430 short tons valued at $661,400. The production in 1902 was 17,404 short tons of refined borax, valued at $2,447,614, of which 862 short tons, valued at $150,000, were stated to be boric acid, and 2,600 short tons of crude borax, valued at $91,000—a total of 20,004 short tons, valued at $2,538,614.

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[a] Bailey, G. E., the saline deposits of California; Bull. California State Mining Bureau No. 24, 1902. Campbell, M. R., reconnaissance of the borax deposits of Death Valley and Mohave Desert; Bull. U. S. Geol. Survey No. 200, 1902.

The figures representing the output of 1903 are all based on the quantity of *crude* ores shipped to the various refineries. Some of the companies shipped to refineries high-grade concentrates, thus making their values seem high as compared with those of other companies. By far the largest proportion of the output was valued at the mines at only $15 per ton; but the concentrates run much higher.

In the chapter on this subject in the report for 1902, the aggregate production was rated chiefly on the basis of the *refined* material which amounted to 17,404 short tons, valued at $2,447,614. This accounts for the apparent discrepancy shown in the figures of the three preceding years, in which the tonnage was greater, but the valuation less than half that of 1902. Had the valuation been taken in 1903 on the refined instead of the crude product, the figures would have been $2,735,000 instead of $661,400, as an increase of about 20 per cent in consumption is acknowledged by manufacturers.

On consultation, however, with the representatives of the principal producers, it was considered best to give tonnage and valuation for 1903 on the basis of the crude instead of the refined output, since the crude is produced in California and the refined is largely made in other States, and is in reality a manufactured article and not strictly a mining product. It takes from 2 to 4 tons of crude borax to make 1 ton of pure anhydrous boracic acid, depending on percentage of the ores handled. When the crude borax is taken to the refinery, soda is added, largely increasing the weight, and when to the cost of the soda are added the costs of labor, freight, management, etc., a crude mining product worth at the mines from $15 to $40 a ton becomes a manufactured product worth on the market from $120 to $140 a ton. When mined and shipped none of the mineral is pure borax, and about six-sevenths of the total is only 25 per cent ore, the other seventh being more or less concentrated, but not refined. The miners themselves agree that in calculating the quantity and value of the production for statistical purposes the crude material only should be considered. For these reasons the writer has given the value of the crude production in 1903 as $661,400, while, were the refined material given its value, the figures would have been approximately $2,735,000. The costs of refining vary with the process, just as costs of mining vary with character of the deposits and with distance of haulage to railroad stations, plus the consequent freight expenses. Hence in the following table the tonnage for 1903 is that of the crude material and the value is the "spot" value at the mines, though this shows an apparent but not a real falling off in aggregate value from the previous year.

The statistics of production of borax in California from 1864 to 1903, inclusive, are given in the following table:

Production of borax in California, 1864–1903.

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	178,475
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	1903	[b] 34,430	661,400

[a] Refined product, including 2,600 short tons of crude, valued at $91,000.
[b] Crude product.

IMPORTS.

The following table gives the imports of borax and borates into the United States from 1867 to 1903, inclusive:

Imports of borax and borates into the United States, 1867–1903.

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	173,906
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	255,196
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

Imports of borax and borates into the United States, 1867–1903—Continued.

Year.	Borax.		Borates, calcium, and sodium (crude and refined sodium borate).		Boric acid.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
1881	4,136	$865	Nil.	Nil.	187,058	$15,771
1882	10,664	3,062	Nil.	Nil.	586,335	71,348
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	48,967
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
1903	68,978	5,727	146,654	13,280	693,619	28,011

WORLD'S PRODUCTION.

The following table gives the production of borax and boron compounds in the principal countries of the world from 1896 to 1902, inclusive:

The world's production of borates, etc., 1896–1902.[a]

[Metric tons.]

Year.	United States. Calcium borate.	Bolivia. Calcium borate.[b]	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	3,065	11,547	162	184	2,558	4,156	(d)
1902	18,148	593	14,437	(e)	196	[f] 2,763	(e)	(g)

[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.

[f] In addition, 375 tons refined borax and 238 tons refined boric acid, all from 12 mines in Province of Pisa.

[g] Annual output estimated at about 9,000 metric tons.

REVIEW OF THE BORAX INDUSTRY DURING 1903.

CALIFORNIA.

From this State comes practically all the borax and boric acid produced in the United States. The deposits are situated in the following localities:

Ventura County.—The Frazier Mountain deposit in Ventura County is about 70 miles west of Bakersfield, Kern County, and is owned by the Frazier Borate Mining Company, controlled by the Stauffer Chemical Company, of San Francisco. The crude ore is shipped by traction engine from the mine to the railroad and thence by rail to San Francisco, where it is refined into borax and boric acid. The ore is considered very high in boric acid contents, running, it is said, from 35 to 45 per cent boric acid. The Columbus Borax Company also owns a deposit near Griffin, Ventura County, which is being developed, but did not reach a productive stage until the summer of 1904.

San Bernardino County.—At and near Daggett, San Bernardino County, deposits are owned by the Borax Consolidated (Limited), the Western Mineral Company, the American Borax Company, the Columbus Borax Company, and the American Board of Promoters Boracic Acid Company.

The Borax Consolidated (Limited) (the old Pacific Coast Borax Company) owns and operates what is called the Calico deposit, which is situated about 11 miles from Daggett in a northeasterly direction. This deposit is not found in what one would call well-defined ledges, but only in pockets which may develop into very large deposits. The mining has not been carried on to any considerable depth—not more than 500 to 600 feet. The mining is very irregular, the larger bodies of ore often being found by accident. Several times the property has been reported by the miners as worked out, but almost every time larger bodies of ore than the previous ones have been found. The mine as a producer has been a wonder, considering that the ore was never found in defined beds. The ore found is a borate mineral called colemanite after Mr. William T. Coleman, the pioneer borax producer on the Pacific slope. The ore varies in percentage of boric acid contained, but is seldom shipped unless it averages 35 per cent or more. Any lower grade is put through the roaster at Marion, where the concentrating plant is situated. The ore not shipped is taken to this plant and there put through a Holthoff-Wethey furnace, built by the Allis-Chalmers Company.

The Western Mineral Company operates a small boric-acid plant about 5 miles directly north of Daggett, and the mine is about 1½ miles from the works in an easterly direction. The ore obtained is a borate of lime. The mine has been closed for the last year, but will be operated again next season.

The American Borax Company operates a boric-acid plant in the town of Daggett. The mine, 7 miles northwesterly, is connected with the works by a railroad, and the ore is hauled to the works for treatment. The ore is a borate of lime varying in boric-acid contents from 7 per cent to 30 per cent, and is treated by a special process patented by Mr. Henry Blumenberg, jr., and described elsewhere in this chapter. The liquors are run out into solar vats and allowed to evaporate. The material is shipped to the Brighton Chemical Company, New Brighton, Pa., and is there converted into borax and refined boric acid. This company is controlled by Messrs. E. L. Dawes, W. A. Myler, and Henry Blumenberg, jr. The Brighton Chemical Company is controlled by the same parties. The results of the work of this company have encouraged others owning low-grade properties in that section, and doubtless other properties will be developed. The deposit is considered almost inexhaustible, and it is understood that the company has ore in sight and blocked out to last for twenty years' work at the present rate of production.

The Columbus Borax Company owns a mine about 5 miles south of Daggett, on which it has developed some good ore averaging 15 per cent, but lately the company has done nothing on it except development work.

The American Board of Promoters Boracic Acid Company has developed a large deposit about 9 miles northeasterly of Daggett, where the ore is a borate of lime. It has six patented claims, with ore bodies containing from 10 to 12 per cent boric acid. A plant is to be erected in the summer of 1904. The name of this company is to be changed to the Palm Borate Company.

The principal source of borax in this Calico and Daggett region of San Bernardino County has thus far been a vein-like deposit of calcium borate of the variety known as colemanite. The chief bed or vein in this deposit is found from 5 to 8 miles east of the old silver mining town of Calico.

Inyo County.—There are large deposits in Death Valley, Inyo County, about 140 miles north of Daggett, controlled largely by the Borax Consolidated (Limited), on which very little work has been done, with one exception. The deposit in Ash Meadows, known as the Leila See mine, has been developed as a precautionary measure in case the mines at Daggett should fail. The mine is 110 miles north of Manvel, on the Atchison, Topeka and Santa Fe Railroad. A wagon road has been completed from Ash Meadows to Manvel, with a grade said to be not over 5 per cent in any place, over which ore is to be hauled by traction engine.

Near Big Pine, in Inyo County, is situated the property of the Western Borax Company, of which Lillienthal & Co., of San Francisco, are agents. This company is now producing borax from marsh dirt or mud containing from 8 to 10 per cent of borax, which is dissolved and then crystallized out.

There are small deposits and prospects of borax all along the Mohave Desert and adjoining the Death Valley country; but as long as the price of borax is as low as at present, with the chances of it falling still lower, very little inducement is held out either to the prospector or the investor, and they must confine themselves to the richer deposits or to such deposits as are near to railroad transportation facilities.

The cost of production in this country depends almost solely on the labor, which is often very unsatisfactory, experience proving this item to amount to about 60 per cent of the total cost. Another drawback to the borax industry is the uncertainty as to the duty, as, with labor forming 60 per cent of the total cost, no one can produce borax in this country with labor at $3 per day and compete with foreign countries where the cost of labor is so much less. Furthermore, the transportation charges are such that, if the duty be in any way tampered with, the mines in the distant desert regions of California can not expect to ship their product 3,000 miles to an eastern seaport over several railroads and compete successfully with a product which is shipped by sea.

The refiners of borax in the United States are: Borax Consolidated (Limited), Bayonne, N. J.; Pfizer & Co., Brooklyn, N. Y.; Brighton Chemical Company, New Brighton, Pa.; Thos. Thirkelson & Co., Chicago, Ill.; Stauffer Chemical Company, San Francisco, Cal.

The refining of borax is held more or less as a trade secret. The materials mainly used in the different refineries are borate ores, boric acid, or crude borax, which are mixed with soda ash and sodium bicarbonate in various proportions and boiled and allowed to crystallize.

As already stated, it has been considered proper to give the figures of production in terms of the crude material for the sake of uniformity. The cost of crude varies very materially with the different producers, owing to local conditions, longer or shorter hauls to railroad, etc. While some producers may deliver their crude to the railroad at a profitable valuation of, say, $15 per ton, the value at that point to others is as high as $40 per ton. Some of it is also semi-refined or concentrated before shipment up to even higher values, being subsequently fully refined at points distant from those of production. Some producers bring their product up to a higher percentage than others before shipping. Some high-class crude ore is shipped directly to the refineries and some is a roasted or semi-refined product.

For description of the various localities in the different counties of California where borate minerals have been found, the reader is referred to the bulletin by Mr. G. E. Bailey on the saline deposits of California, already cited on a preceding page.

USES OF BORAX.

The following are some of the more common uses of borax: When melted at a high temperature, it has the property of dissolving metallic oxides and of forming transparent colored glasses. By this means the various metallic oxides may be distinguished in the flame of the blowpipe in laboratory work. The property of dissolving metallic oxides makes it useful in soldering and brazing metals, as it renders the surfaces to be joined clean, so that the solder runs and fills the joint between them. In welding metals it is used as a flux. In assaying gold and silver ores borax is used in the crucibles or scorifiers to dissolve and remove base metals from the metallic lead button holding the gold and silver of the samples tested. It is used also as a flux in melting gold, silver, and other metals. Of late years it has been extensively used in the manufacture of porcelain-coated ironware known as granite ware. The manufacturers of granite ware and of enameled bath tubs are extensive consumers of borax. It is very largely used in the manufacture of pottery and earthenware as a glaze. It is a constituent of the strass or paste used in the manufacture of glasses and enamels, and is the basis of artificial gems. It is largely used in making the hard, tough grades of glass, and the vitrifiable pigments for stained glass and for encaustic tiles.

On account of its cleansing qualities, borax is extensively used in the household in the form of borax soaps. When powdered, its detersive qualities make it useful in the home and in the laundries for washing textile fabrics. In solution it is used for cleansing the hair, and it forms part also of numerous cosmetics. Cotton goods saturated with a solution of borate of ammonia and then dried are rendered to a certain extent noninflammable. It is utilized as a mordant in calico printing and dyeing, and as a substitute for soap in dissolving gum out of silk. Guignet green, a beautiful pigment used in calico printing, is a borate of chromium. A varnish made of one part borax with five parts shellac is used in stiffening felt hats. With casein, borax forms a substance which is used as a substitute for gum arabic.

A solution of borax in water may be mixed with linseed oil and used for cheap printing. Painters also use a solution of borax as a solvent for shellac. Borate of manganese has been utilized as a drier for paints, oils, and varnishes. Borax is extensively used in tanning where wools and furs are treated, as it cleanses, softens, and prevents the hair from falling out. In the household, it is utilized to drive certain insects away, its presence being specially obnoxious to cockroaches and ants. Borax is very extensively used in preserving foods, more particularly canned beef, etc.

In medicine, according to the United States dispensatory, borax is a mild refrigerant and diuretic. A solution is used as a mild antiseptic.

The list of medical preparations into which boric acid and borates enter and form a part is a long one. In chemistry and metallurgy the borates are used in very many ways. With the gradual cheapening of the product in recent years many new uses for it have been found.

TECHNOLOGY.

In handling colemanite in the Calico district, San Bernardino County, Cal., the ores that are not shipped are taken by the Pacific Coast Borax Company (Borax Consolidated, Limited) to their concentrating plant at Marion, about 6 miles from their mine, and are then put through the Holthoff-Wethey furnace. The ore is simply heated, or mildly roasted, and the borate mineral falls to a powder, the silica, lime carbonate, and other gangue matter being scraped away. The powder or flour is allowed to cool and is then sacked, like the crude ore, and shipped to Bayonne, N. J., to be boiled with sodium carbonate to form borax. It takes from 2 to 4 tons of low-grade ore to make a ton of roasted ore which assays 45 per cent, or more, of boric acid. The pandermite, which is associated with the colemanite in small layers, is generally lost if put through this roasting furnace, as it will not fall to powder like the colemanite, and it either goes out with the gangue matter or melts into a greenish glass, provided there is enough fluxing matter present.

At Bayonne the machinery is driven by sets of independent motors. The crude colemanite reaches these works in sacks, as shipped from California. It is first coarse crushed on the ground floor of the works, and is then conveyed to a Griffin mill, which reduces it to the fineness of flour. It is then carried by a screw conveyor to the foot of an elevator which raises it to the first floor where it is dropped into a 100-ton tank; a proper quantity of sodium carbonate is added, and the whole is boiled with water. After boiling, the solution is drawn into settling tanks on the second floor, and the clear solution is run back to crystallizing vats on the first floor. The sediment is raised by centrifugal vats on the first floor into a filter press of 50 pounds per square inch; the pulp receives finally, however, double that pressure. The liquor drawn from the press flows back to the settling tank, and the refuse cakes are rejected.

The crystallizing vats are of sheet iron, 20 feet long by 6 feet wide and 6 feet 6 inches deep. Two-inch iron pipes are laid across the tops of the vats, from which wires 5 feet long and 0.25 inch in diameter hang into the vats. As the solution cools the borax crystallizes upon the wires and on the sides and bottoms of the vats. After the crystallization, the mother liquor is pumped out and used again as a solvent, and the borax crystals are removed. The crystallized borax is raised to crushing rolls and screens on the fourth floor and there sorted into three sizes, viz: (1) Refined crystals, (2) refined screenings,

(3) granulated borax. The granulated borax is first dried by hot air in an inclined rotary cylinder, and then pulverized in a cyclone pulverizer; then it is caught in dust chambers; and finally it is barreled for the market.

It is found that the borax crystals that form on the wires in the vat are pure, but that those on the sides and on the bottom of the tank have to be redissolved and refined in order to obtain a product of sufficient purity to meet the requirements of the trade.

The "muds" were formerly boiled with sulphuric acid in huge tanks, the calcium borate during the process being decomposed and the boric acid set free in solution, and the lime being converted into insoluble calcium sulphate. The solution was then drawn off and evaporated, and the crystallized boric acid obtained.

The American Borax Company, at Daggett, has improved upon this process by installing sixteen 20,000-gallon digesters, in which the crude muds are subjected to the action of sulphurous acid by the air method instead of the steam method. This is practically leaching the ore instead of boiling it, boric acid of a high grade being secured at a small expense. By this method muds carrying but a small percentage of borates are profitably treated. The liquors are also run out into solar vats and allowed to evaporate. The plant of this company has 7 or 8 acres of evaporating vats. The material is shipped to the Brighton Chemical Company, New Brighton, Pa., and is there converted into borax and refined boric acid by being treated with soda and then recrystallized as a finished product, which has never run under 99.5 per cent of purity since that plant has been operated.

Before being shipped to New Brighton the material is ground and treated by the process referred to, which is one patented by Mr. Henry Blumenberg, jr., managing director of the company. The main feature is the mechanical sulphur burner, intended to convert the sulphur into sulphur dioxide, with a minimum amount of sublimation resulting therefrom. There is a horizontal cylindrical chamber provided with end holes for cleaning and with an axial intake opening at one end with an outlet opening at the other end, through which the sulphurous acid is taken for the particular industrial use desired. Along the top of the cylinder is disposed an air-supply pipe connected with a pipe leading to an air compressor. The air-supply pipe is provided with a series of vertical depending branch pipes which pass down through packing boxes in the cylinder and discharge near the bottom. The cylinder is lined with fire brick and has a safety valve and an air gage. The sulphur is introduced into the cylinder through a door, so arranged as to be operated and closed very quickly. This sulphur burner thus has a burner chamber having a main air-supply pipe under pressure, and a discharge opening, with a second independent air-supply pipe under pressure disposed outside the chamber and having branch pipes projecting therein, means being provided, as stated, for supplying air under pressure to both supply pipes. The sulphur dioxide produced by this burner may be used for reducing ores, or in any other place where burning sulphur is desired.

The Western Mineral Company works borate of lime, which varies in boric acid contents from 6 per cent to 15 per cent. It is hauled down from the mine to the works and then treated with sulphuric acid, which liberates the lime from the boric acid. The pulp is then washed, and the wash liquors are run out into a system of solar vats where the intense heat of the desert regions dries away the water; the boric acid is then scraped up and sacked. The heat in these vats often runs up to 140° in the sun.

Other processes for the manufacture of boric acid from Colemanite were described in the report on the production of borax in 1902.[a] These include the chlorine, or Moore process, the hydrochloric-acid process, the sulphuric-acid process, the ammonia or Bigott process. To these are now to be added the new sulphur dioxide compressed-air method used by the American Borax Company at Daggett, herein described.

Acknowledgments for assistance are due, among others, to Messrs. Henry Blumenberg, jr., of Daggett, and G. E. Bailey, of San Francisco.

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[a] The production of borax in 1902: Extract from Mineral Resources U. S. for 1902, U. S. Geol. Survey 1903, pp. 11-14.

FLUORSPAR AND CRYOLITE.

By Joseph Hyde Pratt.

FLUORSPAR.

PRODUCTION.

The production of fluorspar in 1903 was confined to the same districts and localities in Illinois, Kentucky, Tennessee, and Arizona, whence the production of 1902 was obtained. There was a considerable falling off in the quantity of fluorspar produced in 1903 as compared with that of 1902, due partly to the depression in the iron and steel industries, and also to the stocks of fluorspar on hand that were left over from the previous year. The total production of fluorspar in 1903 was 42,523 short tons, valued at $213,617, a decrease of 5,495 tons in quantity and of $58,215 in value, as compared with the production of 48,018 short tons, valued at $271,832, in 1902.

Of the 1903 production, 30,338 tons, valued at $129,971, were sold in the form of lump fluorspar, as compared with 43,310 tons, valued at $224,832, in 1902, a decrease of 12,972 tons in quantity and of $94,861 in value; 5,235 tons of ground fluorspar, valued at $52,346, were sold in 1903, an increase of 527 tons in quantity and of $5,346 in value, as compared with 4,708 tons, valued at $47,000, sold in 1903; the remaining 6,950 tons, valued at $31,300, of the 1903 production of fluorspar were prepared for market, but not sold, being still held by the producers. This would make the total amount of lump fluorspar produced in 1903 equal to 37,288 tons, valued at $161,271. The average price per ton received for the lump fluorspar was $4.28 per ton, which is 91 cents less than the average price of $5.19 per ton received for the lump fluorspar in 1902. This prevailing low price will account to some extent for the quantity of fluorspar still held by the producers. The highest price received for the lump fluorspar was $11.50 per ton, which was for the Arizona production; the lowest price recorded was $3 per ton, which was received for a portion of both the Kentucky and the Illinois products. The two extremes in price in 1902 for lump fluorspar were $11.50 and $2.85 per ton. The lump fluorspar that is imported into the United States affects the market to some extent, especially when there is any decrease in the demand for this mineral.

The average price per ton received for ground fluorspar was $9.99, an increase of 1 cent per ton as compared with the average price of $9.98 per ton received in 1902.

The number of producers of fluorspar in 1903 was 12 as compared with 18 who reported a production in 1902. These were divided as follows: One in Arizona, 4 in Illinois, 6 in Kentucky, and 1 in Tennessee. There were 4 producers in Kentucky, 1 in Arizona, and 1 in Illinois who reported a production in 1902, but did not report any production in 1903. Kentucky was again the State to have the largest output, which was 27,499 tons of lump fluorspar, valued at $120,600, and 3,336 tons of ground fluorspar, valued at $33,360, a total production of 30,835 tons, valued at $153,960. This is an increase of 1,805 tons in quantity and of $10,550 in value as compared with the production of 29,030 tons, valued at $143,410, in 1902. This increase in value is due to the production of ground fluorspar. There was a large falling off in the production of Illinois, and also in Arizona and Tennessee the production was much less than in 1902. In the following table are given the quantity and value of the fluorspar produced in the United States in 1902 and 1903, by States:

Production of fluorspar in the United States in 1902 and 1903, by States.

State.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Arizona and Tennessee	628	$6,872	275	$2,037
Kentucky	29,030	143,410	30,835	153,960
Illinois	18,360	121,532	11,413	57,620
Total	48,018	271,814	42,523	213,617

As appears from this table the production of Kentucky in 1902 was nearly twice as much as that of all other States, and in 1903 it was nearly three times as much. Besides the 12 producers of fluorspar mentioned above, there were 4 companies in Kentucky and 1 in Illinois which were developing fluorspar properties in 1903, and expect to be producers of this mineral in 1904.

The annual production of fluorspar in the United States since 1882 is given in the following table:

Production of fluorspar in the United States, 1882–1903, 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	48,018	271,832
1892	12,250	89,000	1903	42,523	213,617

As is shown by this table, the production of 1903, although 5,495 tons less than that of 1902, is more than twice that of 1900 or 1901 and nearly three times that of 1899. This illustrates the decided advance that is being made in the use of this mineral, especially for metallurgical purposes.

IMPORTS.

As there are no separate statements regarding the amount of fluorspar in the records of the Bureau of Statistics, it can not be stated how much of this mineral is imported and enters into competition with the domestic product. During the last year its competition has been felt to some considerable extent, and as far as can be judged the importation was greater in 1903 than in 1902.

There is a certain amount of calcium fluoride produced as a by-product in the reduction of the mineral cryolite which is imported from Greenland, and its importation determines the quantity of this artificial fluoride that is made. It usually amounts to from 3,000 to 4,000 tons per year, and is used as a flux in open-hearth furnaces, giving the same results as the natural fluoride, which occurs as the mineral fluorspar or fluorite.

CRYOLITE.

PRODUCTION AND IMPORTS.

There was no production of this mineral in the United States during 1903, and, although it had been found sparingly at a number of localities, none of these have shown any indication of containing the mineral in commercial quantity. All of the cryolite used in this country is imported from Greenland, where the production is controlled by the Danish Government, which also limits the exportation.

The principal use of the cryolite imported into the United States is in the manufacture of aluminum and sodium salts, and it is in this process that the calcium fluoride is obtained as a by-product.

In the table below is given the quantity and value of cryolite imported into the United States since 1871:

Imports of cryolite, 1871–1903.

Year ending—	Amount.	Value.	Year ending—	Amount.	Value.
June 30—	*Long tons.*		December 31—	*Long tons.*	
1871		$71,058	1887	10,328	$133,068
1872		75,195	1888	7,388	98,830
1873		84,226	1889	8,608	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	1894	10,684	142,494
1879		66,042	1895	9,425	125,368
1880		91,366	1896	3,009	40,056
1881		108,529	1897	10 115	135,114
1882	3,758	51,589	1898	6,201	86,501
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	1903	7,708	102,879

GYPSUM AND GYPSUM PRODUCTS.[a]

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 1903 are set forth in the following table. For the sake of comparison the production for 1902 is also given. The total production is estimated as crude, while the total value is that of the product in its different forms as it first reaches the market.

Production of gypsum in United States, 1903.

Grade.	Quantity.	Value.	Average price per ton.
	Short tons.		
Crude	73,912	$87,608	$1.19
Land plaster	74,601	154,945	2.08
Plaster of Paris	264,196	1,078,287	4.08
Wall plaster	478,847	2,472,103	5.17
Total (estimated as crude)	1,041,704	3,792,943	....

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
Plaster of Paris	188,702	562,928	2.98
Wall plaster	350,685	1,326,262	3.78
Total (estimated as crude)	816,478	2,089,341	....

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 plaster of Paris and wall plaster in 1903 was much greater than in 1902. Much of the gypsum sold as plaster of Paris is subsequently manufactured into wall

[a] For a discussion of the gypsum deposits of the United States, their geological occurrence and economic development, readers are referred to Bulletin No. 223 of the United States Geological Survey "Gypsum deposits in the United States," by George I. Adams. It may be had upon application to the Director.

The statistical work in this report has been carried on by Miss E. L. D. Patterson, of the United States Geological Survey.

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 fourteen years. The annual production and value of the three varieties of gypsum—crude, ground, and calcined—are given, together with the value per ton of each. It appears from the following and the preceding tables that the production of plaster of Paris in 1903 was 264,196 short tons, as against 188,702 short tons in 1902, and that the production of wall plaster was 478,347 short tons, as against 350,685 tons in 1902—a combined production in 1903 of 742,543 short tons, as compared with a combined production of 539,387 tons in 1902 and of 399,686 tons in 1901. The proportion of crude gypsum calcined to the total crude production rose from 80 per cent in 1901 to about 83 per cent in 1902 and to about 86 per cent in 1903, but the total calcined production in 1903 was more than the total crude production of 1901 by about 108,000 tons. The increase in value per ton of the calcined gypsum from $3.31 in 1901 to $4.77 in 1903 is also to be noted. 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, 1890–1903, 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
1903	1,041,704	73,912	87,608	1.19	74,601	154,945	2.08

Production of gypsum in the United States, 1890–1903, 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
1903	893,191	742,543	3,550,390	4.77	3,792,943

PRODUCTION BY STATES.

At present the gypsum industry is carried on commercially in 22 States and Territories, which, named in the order of their importance as producers, are Michigan, New York, Iowa, Texas, Ohio, Oklahoma, Kansas, Wyoming, Colorado, Utah, Virginia, California, South Dakota, Nevada, Montana, Oregon, and New Mexico.

The other five States do not produce gypsum, but contain large plants to which the raw material is shipped and converted into wall plaster and plaster of Paris.

A deposit of gypsum has been observed near Lake Panasoffkee, in Florida, occurring in a low-lying area of hummock land known as Bear Island. In the southern and southwestern parts of this area the gypsum is covered by only an inch or two of vegetal mold, and can be dug up soft like clay, but it hardens on exposure to the air. Two pits sunk through it have shown it to be from 6 to 7 feet in thickness. The quality is practically uniform. 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, Oklahoma, and Ohio.

New York.—The gypsum deposits of New York extend in a narrow belt through the west central part of the State. Those that are worked vary from 4 to 10 feet in thickness in most of the quarries, but at Fayetteville a 30-foot bed is exposed. These deposits are developed at Oakfield, Wheatland, Mumford, Garbutt, Victor, Port Gibson, Alabama, Union Springs, Marcellus Falls, Fayetteville, Manlius, Jamesville, Cottons, Clockville, Perryville, and Valley Mills. Many of the deposits are too impure to be used in the finer grades of plaster of Paris, since they contain small amounts of earthy matter, lime, and iron, and hence at a number of places the industry is only of local importance, the production being confined to land plaster. Within the last few years, however, several large plants have commenced the manufacture of calcined plaster, the gypsum used for this purpose being obtained largely from Genesee County.

Virginia.—The gypsum-producing locality in Virginia is confined to a small area in the southwestern part of the State, in the valley of the North Fork of Holston River. The known deposits are all in a narrow belt about 16 miles in length. The beds of gypsum average 30 feet in thickness at the localities where they are worked. The development of the industry in the State has been governed largely by transportation facilities, the extensive deposit in the upper valley of the Holston not having been exploited on account of the long wagon haul necessary. The deposits at Plasterco and Saltville have furnished the principal output. The Virginia gypsum, as shown by several analyses, is of remarkable purity. The product is marketed partly as land plaster and partly as wall plaster.

Ohio.—The gypsum deposits of Ohio, which are of economic value, consist principally of beds of rock gypsum, and their existence has been known since the first settlements were made on the shores of Sandusky Bay. Gypsum is also found in small pockets throughout the northwestern part of the State. The deposits which are worked vary in thickness from a few inches to 9 feet. The principal ledges are of a grayish hue, due to carbonaceous matter, but the gypsum itself is pure white. The industry has increased rapidly in the last few years. At the present time there are two calcining plants in operation, and a number of companies are engaged in the manufacture of wall plaster. The greater part of the product is used for wall plaster and in the manufacture of plate glass, and a smaller quantity in the making of crayons and pottery molds, and as land plaster.

Michigan.—The deposits of economic importance in Michigan are developed in two parts of the State—in the vicinity of Grand Rapids and on the border of Lake Huron, near Alabaster, where the gypsum can be seen extending out from the shore under the water. The gypsum is of the massive rock variety, occurring in heavy ledges, and is of a high degree of purity. The product is marketed principally as calcined gypsum and wall plaster, and partly as land plaster.

Iowa.—The gypsum deposits of Iowa, so far as known, are confined to an area of 60 to 70 square miles in Webster County, near the center of the State. These deposits consist of a single bed, practically horizontal, and varying from 10 to 25 feet in thickness. The development of this industry is limited to the region immediately about Fort Dodge, where eight mills are at present in operation. The nature of the gypsum and the coloring of the bands is such as to render it peculiarly fit for hardening, so that it may be used in the imitation of marble. Analyses show the upper layers to be remarkably pure. The product is principally wall plaster and plaster of Paris, a relatively small amount being sold as land plaster.

Kansas.—The gypsum beds of Kansas extend in an irregular belt northeast and southwest across the State. This belt is naturally divided into three districts which, from the important centers of manufacture, may be called the Blue Rapids, the Gypsum City, and the Medicine Lodge areas. A number of smaller areas have been developed between these points, connecting more or less closely the three main divisions. The excellent transportation facilities make it a good field for manufacture, but the largest area, near Medicine Lodge, is not reached by any trunk-line railroad, which has hindered its development. The deposits consist of extensive beds of rock gypsum, and there are many deposits of secondary gypsum or gypsite. Some of the rock is well suited for the manufacture of the finer grades of plaster of Paris, while the gypsite is adapted for wall and cement plasters, four of the nine Kansas mills now using it for that purpose.

Oklahoma.—The gypsum deposits of Oklahoma are estimated at 125 billion tons, and occur principally in the western half of the Territory. The industry has been comparatively little developed, due in large part to the fact that the country is but newly settled and to the consequent lack of railroad facilities. At the present time there are but four mills in operation. The most easterly deposits, those in Kay County, consist of gypsum dirt or gypsite. In the other districts rock gypsum predominates, although there are numerous localities where gypsite occurs in workable bodies. The product is chiefly wall plaster.

Texas.—The largest gypsum deposit in Texas lies east of the Staked Plains, extending northeast and southwest from the Red River to the Colorado, and is from 20 to 50 miles wide. The beds vary in thickness from that of a knife blade to 20 feet. In the eastern part of El Paso County, to the east of Guadaloupe Mountains, is an area of gypsum, which is conspicuously exposed along the course of Delaware Creek. The section of these beds is from 300 to 500 feet in thickness, and shows gypsum of all varieties and of varying degrees of purity. At the present time the deposits are utilized only at Acme and Quanah, on the northern border of the State. The product is marketed very largely as wall plaster.

Montana.—Gypsum deposits are widely distributed throughout the eastern flanks of the Rocky Mountain region of Montana, and vary from a few inches to 6 feet and more in thickness. These deposits have been exploited at two localities, one near the towns of Kibbey and Armington, in Cascade County, and the other at Bridger, in Carbon County. The deposits are generally pure and free from foreign material, and very commonly impregnate the waters of the streams and springs, making them unfit for use. The product of the existing plants is principally wall plaster.

South Dakota.—The gypsum-producing areas of South Dakota are confined to the Black Hills uplift in the extreme western part of the State. The thickness of the deposits varies greatly, 30 feet of pure white gypsum occurring in some districts. The gypsum is a prominent feature about Hot Springs, where the beds have a thickness of 33 feet. Owing to remoteness from market, these deposits have not been utilized to any great extent. Mills are in operation at Hot Springs and Spearfish, the product being marketed chiefly as wall plaster.

Wyoming.—The gypsum deposits in Wyoming of economic importance are wholly confined to the Red Beds. In all, there are about 1,500 miles of the gypsum-bearing formation exposed, and throughout this great linear extent beds occur varying from 5 to 20 feet in thickness, and beds 30 to 50 feet thick are not uncommon. It is of excellent quality, and can be used in the manufacture of all the gypsum products. Besides the rock gypsum there are secondary surficial deposits of impure gypsum, or gypsite. Development is being carried on at Laramie, Red Buttes, and Sheridan, the product being principally wall plaster.

Colorado.—The gypsum which is worked in Colorado consists of massive beds which outcrop at intervals along the eastern foothills of the Rocky Mountains. There are also numerous other deposits which have not been exploited. The deposits already developed reach a thickness of 30 feet in places, and some of them are of very satisfactory quality. Gypsum has been worked extensively near Loveland, and during the last few years the industry has been confined largely to this locality, and to Perry Park, Colorado City, and Canyon, the product being principally calcined plasters.

New Mexico.—Gypsum is found so generally distributed in New Mexico and occurs in such vast deposits and in such variety of forms that the supply is practically inexhaustible. Until 1902 no attempt to utilize it in a commercial way had proved successful, owing to excessive freight rates and to the small market. The White Sands, in Otero County, constitute one of the most remarkable accumulations of gypsum known; it is a tract of dunes of nearly pure gypsum, covering about 350 square miles. At present the only development is at Ancho, in Lincoln County.

Arizona.—The known gypsum-producing localities of Arizona lie principally in the southeastern quarter and to the northeast, in Navajo County.* The thickness of the beds varies greatly. The mineral occurs in all forms, from a compact granular structure to a fibrous variety. Gypsum has been quarried for economic purposes in the Santa Catalina region, and in the vicinity of Woodruff and Snowflake, in Navajo County.

Utah.—Large deposits of gypsum have been found in several parts of Utah, and it is not improbable that others will be discovered in the course of development. The most important known deposits occur in the central and southeastern portions of the State. They are all of the rock-gypsum type except the one in Millard County, which is of the form of granular gypsum blown up from desiccated playas into dunes. Enormous deposits have been reported from Iron County, but at points so far distant from transportation lines as to render their exploitation impracticable at the present time. The deposit at Nephi is the only one in the State now developed to any extent.

Nevada.—Gypsum has been found at a number of places in Nevada, but its distribution and extent can not be given, as a systematic exploration of the State has not been made. The best known deposits are in the northwestern quarter. They are of massive, compact, or granular rock-gypsum, almost pure, and make a fine grade of plaster. Gypsum dirt is found lying on the surface of the beds or on the lower hill slopes and depressions. The deposits have been developed commercially at Lovelocks and Moundhouse.

California.—The gypsum deposits of California, though widely distributed, are not generally of sufficient size and purity to make them of great commercial value. Comparatively little gypsum is mined for manufacture owing largely to cheap transportation from points outside the State. The larger deposits are mostly of a character to be of value as land fertilizer, and this industry bids fair to become of considerable economic importance.

Oregon.—The only deposit of gypsum known to occur in Oregon is on the eastern border of the State, on a ridge dividing Burnt and Snake rivers. It consists of beds of rock-gypsum of good quality and well adapted for economic purposes, but in part containing thin strata of greenish chloritic mineral. These beds have been developed recently at Lime, on Burnt River, from which point a winding road ascends a ridge about 1,500 feet above the level of the river. The gypsum occurs about 200 feet below the summit of the ridge on the slope facing Snake River.

In the following tables, which show the production of gypsum, by States, for 1902 and 1903, 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 1903, 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	103,392	1,337	$2,531	13,065	$34,760	88,990	74,158	$129,822	$167,113
Colorado and Wyoming	33,549	....	....	100	500	33,449	27,874	132,847	133,347
Iowa, Kansas, and Texas	307,102	9,208	14,861	2,976	6,242	294,918	244,072	1,065,942	1,087,045
Michigan	269,093	52,565	51,900	18,409	27,949	198,119	165,122	621,063	700,912
New York	137,885	9,304	15,439	37,850	77,392	90,732	75,613	369,552	462,383
Oklahoma	69,158	698	877	1	2	68,459	57,049	233,742	234,621
Other States	121,524	800	2,000	2,200	8,100	118,524	98,655	697,422	707,522
Total	1,041,704	73,912	87,608	74,601	154,945	893,191	742,543	3,550,390	3,792,943

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	816,178	81,455	93,914	60,791	106,237	674,232	539,387	1,889,190	2,089,341

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 1901, inclusive, are shown in the following table:

Production and value of gypsum by States, 1890–1901.

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	196,197
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

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	1,871	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	272,581
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	59,821
Ohio	11,646	39,884	20,827	69,597	21,662	71,204
Oklahoma	....	....	1,800	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	2,184	11,484
Virginia	7,014	24,359	8,106	24,431	5,800	17,869
Wyoming	....	....	312	1,500	375	2,400
Total	253,615	696,615	239,312	761,719	265,503	807,447

Production and value of gypsum by States, 1890–1901—Continued.

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	82,812	33,440	78,684	31,655	81,969
Ohio	22,634	63,583	18,592	50,856	21,308	61,884
Oklahoma	....	....	....	....	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	10,000
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

State or Territory.	1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Arizona	47	$1,200	35	$900	....	....
California	2,950	14,950	3,280	10,088	3,550	$4,200
Colorado	871	3,904	967	5,300	13,291	64,772
Indian Territory	12,000	26,000	6,500	15,000	....	....
Iowa	75,574	296,220	184,600	561,588	63,653	160,788
Kansas	85,046	247,690	48,636	150,257	69,390	213,260
Michigan	144,776	283,537	129,654	285,119	185,150	267,243
Montana	582	3,698	1,025	7,960	....	....
New York	52,149	105,533	58,890	150,588	119,565	241,669
Nevada	....	....	1,000	4,805	....	....
Ohio	27,205	73,520	39,034	119,946	....	....
Oklahoma	11,526	36,600	18,437	60,380	15,990	66,031
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	80,376	255,288
Utah	2,352	10,240	2,397	4,984	....	....
Virginia	11,480	32,043	11,940	18,111	15,286	45,144
Wyoming	4,804	21,050	4,845	24,229	4,103	11,663
Other States	....	....	....	....	63,547	176,563
Total	486,235	1,287,080	594,462	1,627,203	633,791	1,506,641

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 and 1903.

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 manfacturers of fertilizers mix it with their product. The fol- fowing tables, reported by the Bureau of Statistics, show the imports for the fiscal years given by countries and by customs districts in which they were entered:

Imports of crude, ground, or calcined (dutiable) gypsum, by countries, in the fiscal years ending June 30, 1900, 1901, 1902, and 1903.

Country from which imported.	1903.		1902.		1901.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
France	57	$395	132	$1,902	185	$1,311	342	$2,397
United Kingdom	333	5,422	190	1,854	93	987	59	836
Nova Scotia and New Brunswick	288,366	319,497	259,353	275,877	196,932	216,636	203,347	234,563
Mexico					2,236	9,700	1,014	4,500
Other countries	22	371	20	23	1	86	88	602
Total	288,778	325,685	259,695	279,656	199,447	228,670	204,850	242,898

Imports of crude, ground, or calcined (dutiable) gypsum, by customs districts, in the fiscal years ending June 30, 1900, 1901, 1902, and 1903.

Customs district into which imported.	1903.		1902.		1901.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
Aroostook, Me	128	$518	57	$148	415	$796	290	$448
Bangor, Me			235	141	390	234	153	92
Bath, Me	883	582	703	429	740	446	736	966
Passamaquoddy, Me	11,394	11,131	8,395	7,628	8,232	7,942	9,503	10,530
Portland and Falmouth, Me					180	135		
Boston and Charlestown, Mass	9,120	19,420	5,760	11,546	5,921	11,118	6,450	11,925
Gloucester, Mass			235	144	230	141		
Fairfield, Conn	310	930	360	990	315	866	284	688
New Haven, Conn	4,806	3,490	3,515	3,124	1,916	1,325	3,942	2,818
New York, N. Y	169,232	184,935	157,699	167,444	117,989	138,565	121,728	150,074
Newark, N. J	33,345	38,869	30,388	35,091	19,700	21,751	21,491	22,857
Perth Amboy, N. J	4,910	3,795	6,218	3,733	2,780	1,661	4,230	2,538
Philadelphia, Pa	42,849	52,362	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	2,925	2,487	3,987	3,040	5,635	3,381	3,822	2,834
Norfolk and Portsmouth, Va	5,300	4,513	5,600	4,815	7,480	4,488	5,715	3,746
Alexandria, Va	3,565	2,605	1,550	930			2,000	1,320
San Francisco, Cal					2,236	9,700	1,014	4,500
Other districts	11	98	20	22	1	72	32	333
Total	288,778	325,685	259,695	279,656	199,447	228,670	204,850	242,898

Gypsum imported and entered for consumption in the United States, 1867–1903.

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	98,772	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	6,969	140,567
1879	....	18,339	96,963	99,027	8,176	125,542
1880	....	17,074	120,827	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	3,617	23,225	305,367	284,942	52,533	360,700
1903	3,526	22,784	265,958	301,379	144,434	468,597

[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 being the first. Canada is third, Great Britain fourth, and Germany fifth. In the following table the production of the various countries since 1893 is set forth:

The world's production of gypsum, 1893-1903.

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	2,673,083	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	1,975,513	3,318,070	816,478	2,089,341	332,045	356,317
1903	(a)	(a)	1,041,704	3,792,943	307,489	384,259

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	208,151	325,513	28,321	13,228	40,510	109,648
1898	219,549	345,882	28,315	13,166	41,156	110,660
1899	238,071	372,078	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	251,629	384,263	34,944	12,732	[c] 6,889	52,253
1903	(a)	(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)	7,784	17,041
1902	(a)	(a)	7,874	17,443
1903	(a)	(a)	(a)	(a)

[a] Not yet available. [b] Includes Baden. [c] Includes Tunis.

PHOSPHATE ROCK.

By Edmund Otis Hovey.

PRODUCTION.

The consolidation of the various interests in control of phosphate properties, which has been going on for several years, continued during 1903. But, in spite of this consolidation, although the average price per ton of the rock at the mines was greater than in 1902, it was less than during any one of the preceding three years.

The State of Florida continues to be the largest producer of phosphate rock, her output forming more than half the total production of the country. A comparison of the production by varieties in that State during 1903 and 1902 shows that there has been a decrease of nearly 4 per cent in the output of hard rock, an increase of more than 11 per cent in that of land pebble, and that more than ten times as much river pebble was mined last year as in the year before. The increase in the production of river pebble is due to the fact that the calcining plant of the sole operating company, which was destroyed in January, 1902, was in commission again. The comparative production of the last two years in Florida may be summarized as follows:

Hard rock, 412,876 long tons, valued at $1,988,243 in 1903, as compared with 429,384 long tons valued at $1,743,694 in 1902. The average price obtained increased from $4.06 in 1902 to $4.81 in 1903, free on board at the mines.

Land pebble, 390,882 long tons valued at $885,425 in 1903, as compared with 350,991 long tons valued at $810,792 in 1902, a slight decrease in average value.

River pebble, 56,578 long tons valued at $113,156 in 1903, as compared with 5,055 long tons valued at $9,711 in 1902, a slight increase in average value.

The total production was 860,336 long tons, valued at $2,986,824, in 1903, as compared with 785,430 long tons, valued at $2,564,197, in 1902, which shows an average increase in value at the mines from $3.26 in 1902 to $3.47 in 1903. The reports show that during 1903, 29,242 long tons were mined but not marketed, and only the quantities marketed are taken account of in this report.

In South Carolina the diminution in production which has been shown by the reports for the last five years has continued, the falling off being particularly noticeable in the amount of river rock marketed. The total production of South Carolina phosphate rock in 1903 was 258,540 long tons, valued at $783,803, as compared with 313,365 long tons, valued at $919,725, in 1902, the quantities and values being distributed between the two varieties of rock mined as follows: Land rock, 233,540 long tons, valued at $721,303, in 1903, as compared with 245,243 long tons, valued at $753,220, in 1902. River rock, 25,000 long tons, valued at $62,500, in 1903, as compared with 68,122 long tons, valued at $166,505, in 1902.

Tennessee showed in 1903 the largest marketed output since the beginning of the industry, ten years ago. During 1903 a total of 460,530 long tons, valued at $1,543,567, was produced, as compared with 390,799 long tons, valued at $1,206,647, during 1902.

North Carolina again appears in the table as a small producer, while Pennsylvania and other States drop out, with the exception of Arkansas, which produced 2,300 long tons, valued at $4,600, in 1903, as compared with 550 long tons, valued at $1,650, in 1902.

The reports made to the United States Geological Survey show that the total quantity of phosphate rock marketed during 1903 amounted to 1,581,576 long tons, valued at $5,319,294, as compared with 1,490,314 long tons, valued at $4,693,444, in 1902, an increase in quantity of 91,262 long tons and in value of $625,850.

The total quantity of phosphate rock reported as having been mined during 1903 was 1,618,799 long tons, as compared with 1,499,617 long tons in 1902.

The following table gives the production of phosphate rock in the United States from 1892 to 1903, inclusive, based on the marketed product, classified by kinds or grades:

Production of phosphate rock in the United States, 1892–1903, based on the quantity marketed.

State.	1892.		1893.		1894.		1895.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Florida:	*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
Hard rock....	[a] 155,908	$859,276	215,685	$1,117,732	326,461	$979,383	307,098	$1,302,096
Soft rock.....	6,710	32,418	13,675	64,626	....	....	6,916	32,000
Land pebble.	21,905	111,271	86,624	359,127	98,885	296,655	181,011	593,716
River pebble.	[b] 102,820	415,453	122,820	437,571	102,307	390,775	73,036	185,090
Total.......	287,343	1,418,418	438,804	1,979,056	527,653	1,666,813	568,061	2,112,902
South Carolina:								
Land rock ...	243,653	1,236,447	308,435	1,408,785	307,305	1,252,768	270,560	898,787
River rock ...	150,575	641,262	194,129	748,229	142,803	492,808	161,415	512,245
Total.......	394,228	1,877,709	502,564	2,157,014	450,108	1,745,576	431,975	1,411,032
Tennessee	....	....	....	....	19,188	67,158	38,515	82,160
Grand total	681,571	3,296,127	941,368	4,136,070	996,949	3,479,547	1,038,551	3,606,094

[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, 1892–1903, based on the quantity marketed—Continued.

State.	1896.		1897.		1898.		1899.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Florida:	*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
Hard rock....	296,811	$1,067,525	360,147	$1,063,713	366,810	$1,396,108	460,297	$2,119,130
Soft rock.....	400	2,800	2,800	4,600	....	....	....	....
Land pebble.	97,986	176,972	92,132	180,794	155,084	293,688	177,170	515,458
River pebble.	100,052	300,556	97,763	244,408	79,000	158,000	88,953	169,473
Total.......	495,199	1,547,853	552,842	1,493,515	600,894	1,847,796	726,420	2,804,061
South Carolina:								
Land rock ...	267,072	792,457	267,380	748,050	298,610	856,225	223,949	738,969
River rock ...	135,351	389,192	90,900	238,522	101,274	251,047	132,701	339,130
Total.......	402,423	1,181,649	358,280	986,572	399,884	1,107,272	356,650	1,078,099
Tennessee	26,157	57,370	128,723	198,115	308,107	498,392	430,192	1,192,916
North Carolina ..	7,000	17,000	....	....	....	....	440	(*a*)
Pennsylvania....	....	....	....	....	....	....	2,000	9,000
Alabama.........	....	....	....	....	....	....	....	....
Arkansas	....	....	....	....	....	....	....	....
Other States......	....	....	....	....	....	....	....	....
Grand total	930,779	2,803,872	1,039,345	2,673,202	1,308,885	3,453,460	1,515,702	5,084,076

State.	1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Florida:	*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
Hard rock....	424,977	$2,229,373	457,568	$2,393,080	429,384	$1,743,694	412,876	$1,983,243
Land pebble.	221,408	612,703	247,454	660,702	350,991	810,792	390,882	885,425
River pebble.	59,863	141,236	46,974	105,691	5,055	9,711	56,578	118,156
Total.......	706,248	2,983,312	751,996	3,159,473	785,430	2,564,197	860,336	2,986,824
South Carolina:								
Land rock ...	266,186	877,406	225,189	716,101	245,243	753,220	233,540	721,303
River rock ...	62,987	164,565	95,992	245,739	68,122	166,505	25,000	62,500
Total.......	329,173	1,041,970	321,181	961,840	313,365	919,725	258,540	783,803
Tennessee........	454,491	1,328,707	409,653	1,192,090	390,799	1,206,647	460,530	1,543,567
North Carolina ..	....	....	....	....	....	....	45	500
Pennsylvania....	900	4,500	893	3,000	100	400	....	....
Alabama.........	334	534	....	....	....	....	....	....
Arkansas	75	225	....	....	550	1,650	2,125	4,600
Other States	....	....	....	....	70	825	....	....
Grand total	1,491,216	5,359,248	1,483,723	5,316,403	1,490,314	4,693,444	1,581,576	5,319,294

a Value included in South Carolina land rock.

Since 1880 the quantity and the value of the phosphate rock produced (marketed) in the United States have been as follows:

Sales of phosphate rock in the United States, 1880–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1880	211,377	$1,123,823	1892	681,571	$3,296,227
1881	266,734	1,980,259	1893	941,368	4,136,070
1882	332,077	1,992,462	1894	996,949	3,479,547
1883	378,380	2,270,280	1895	1,038,551	3,606,094
1884	431,779	2,374,784	1896	930,779	2,803,372
1885	437,856	2,846,064	1897	1,039,345	2,673,202
1886	430,549	1,872,936	1898	1,308,885	3,453,460
1887	480,558	1,836,818	1899	1,515,702	5,084,076
1888	448,567	2,018,552	1900	1,491,216	5,359,248
1889	550,245	2,937,776	1901	1,483,723	5,316,403
1890	510,499	3,213,795	1902	1,490,314	4,693,444
1891	587,988	3,651,150	1903	1,581,576	5,319,294

The quantity in 1903 is the largest ever reported, but the value was exceeded in 1900.

PRODUCTION BY STATES.

FLORIDA.

During the year 1903 there were mined in Florida 889,578 long tons of phosphate rock, while sales of but 860,336 long tons were reported, leaving at the end of the year a stock on hand of 29,242 long tons. All of the reported stock on hand was of the hard-rock variety. As may be seen by the subjoined table, the quantities of the different varieties marketed were as follows: Hard rock, 412,876 long tons; land pebble, 390,882 long tons; river pebble, 56,578 long tons. The relative proportions were, approximately, hard rock, 48.2 per cent; land pebble, 45.4 per cent; river pebble, 6.6 per cent. The mining of soft rock has not been reported since 1897, when 2,300 long tons were sold.

The following table gives the quantity and value of each grade or variety of phosphate rock produced in Florida from 1897 to 1903, inclusive, based upon the reports of marketed material:

Quantity and value of phosphate rock marketed in Florida, 1897–1903, classified by grades.

Year.	Hard rock.		Soft rock.		Land pebble.		River pebble.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
1897	360,147	$1,063,713	2,300	$4,600	92,132	$180,794	97,763	$244,408	552,342	$1,493,515
1898	366,810	1,396,108	Nil.	....	155,084	293,688	79,000	158,000	600,894	1,847,796
1899	460,297	2,119,130	Nil.	....	177,170	515,458	88,953	169,473	726,420	2,804,061
1900	424,977	2,229,373	Nil.	....	221,403	612,703	59,863	141,236	706,243	2,983,312
1901	457,568	2,393,080	Nil.	....	247,454	660,702	46,974	105,691	751,996	3,159,473
1902	429,384	1,743,694	Nil.	....	350,991	810,792	5,055	9,711	785,430	2,564,197
1903	412,876	1,988,243	Nil.	....	390,882	885,425	56,578	113,156	860,336	2,986,824

The total quantity and value of the phosphate rock produced (marketed) in Florida since 1888, when the first was exploited, is shown in the following table:

Output of phosphate rock in Florida, based on marketed product, 1888–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1888	3,000	$21,000	1897	552,342	$1,493,515
1889	4,100	28,000	1898	600,894	1,847,796
1890	46,501	338,190	1899	726,420	2,804,061
1891	112,482	703,013	1900	706,243	2,983,312
1892	287,343	1,418,418	1901	751,996	3,159,473
1893	438,804	1,979,056	1902	785,430	2,564,197
1894	527,653	1,666,813	1903	860,336	2,986,824
1895	568,061	2,112,902	Total	7,466,804	27,653,923
1896	495,199	1,547,353			

The record of the Florida hard-rock phosphate production prepared by Messrs. Auchincloss Brothers shows that the total shipments of hard rock during 1903, as reported to them, were 467,872 long tons, as compared with 492,610 long tons during 1902, which is a decrease of 24,738 long tons, or 5 per cent. The condition of the hard-rock industry is indicated by the following table, which gives the number of plants in operation, idle, and in course of construction during the period from 1896 to 1903, inclusive:

Number and condition of hard-rock plants in Florida, 1896–1903.

Year.	In operation.	Idle.	Under construction.	Total.
1896	38	49	3	90
1897	38	36	2	76
1898	43	25	5	73
1899	58	13	10	81
1900	51	22	5	78
1901	40	29	3	72
1902	50	17	3	70
1903	48	7	5	60

The 60 plants which are here accounted for in 1903 are reported as being owned or operated by 20 companies or individuals. Thirty-seven of the number, however, were owned or operated by 3 companies, which indicates that the industry is tending toward consolidation among a few corporations. In 1900, the plants were operated by 50 separate individuals or companies.

The following table of production, shipments, and stock on hand at the beginning of the year, during the period from 1896 to 1903, inclusive, has been prepared by Messrs. Auchincloss Brothers:

Stocks, shipments, and production of hard rock in Florida, 1896–1903.

Year.	Production.	Shipments.	Stock January 1.
	Long tons.	*Long tons.*	*Long tons.*
1896	299,314	322,871	159,051
1897	300,847	350,277	135,494
1898	323,500	360,505	86,064
1899	497,754	444,675	49,059
1900	458,118	348,556	102,138
1901	400,880	424,130	211,700
1902	476,110	a 492,610	187,950
1903	423,872	467,872	171,450
1904			127,450

a To foreign ports, excepting 2,104 tons which were shipped to Honolulu.

Although the price of hard rock advanced materially in 1903, the cost of operating the mines has increased to such an extent that the profits of mining in 1903 were no greater than, if as great as, during the preceding year. The stock on hand at the beginning of the year shows a steady decrease for the last three years.

The following tables of shipments of Florida phosphate rock since 1896, by months, countries, and years, have been taken from the same report of Messrs. Auchincloss Brothers:

Total shipments of Florida hard-rock phosphate, by months, 1896–1903.

Month.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
January	16,996	12,924	11,682	28,560	23,359	17,673	19,113	15,222
February	16,853	20,668	26,850	32,630	28,623	32,412	24,265	22,306
March	37,155	37,243	34,049	43,051	25,282	44,751	35,996	48,869
April	36,559	32,608	22,274	59,001	52,398	35,945	57,185	74,351
May	45,846	45,715	31,992	48,584	44,598	33,349	35,987	39,913
June	16,511	32,837	31,948	23,051	21,950	23,039	47,452	29,805
July	15,296	22,639	53,114	48,747	38,822	28,791	42,700	34,426
August	19,914	19,292	27,409	41,155	21,491	57,497	16,485	25,646
September	25,116	59,966	46,961	35,728	20,711	51,781	72,516	47,096
October	30,605	27,664	21,476	36,694	26,174	49,093	70,123	47,430
November	38,402	20,184	30,595	28,947	24,222	30,326	42,180	33,622
December	23,618	18,537	22,155	18,527	20,976	19,473	23,606	39,179
Total	322,871	350,277	360,505	444,675	348,556	424,130	492,610	467,872

The following is the record of shipments to each country for the last eight years:

Shipments of Florida hard-rock phosphate, by countries, 1896–1903.

Country.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
England	20,533	24,163	23,849	31,789	20,542	28,790	30,068	28,246
Scotland	1,038	5,957	6,000	9,545	1,790	6,185	12,430	5,311
Ireland	513	2,953	3,420	....	5,852	5,175	8,850	9,714
Germany	151,461	181,355	186,731	243,887	208,422	214,280	264,550	246,824
Belgium	27,214	22,954	38,903	37,103	31,639	58,181	41,245	35,400
Holland [a]	47,235	53,039	64,309	87,167	54,349	72,158	77,176	73,280
Denmark	9,594	11,019	8,287	5,475	2,930	12,814	2,750	11,870
Norway and Sweden	12,534	7,442	9,378	11,938	8,000	....	10,250	15,862
France	6,986	13,931	....	3,165	....	6,498	3,950	5,865
Italy	32,999	16,931	11,040	4,546	....	5,842	16,363	18,542
Russia	1,607	3,618	....	1,700	2,702	....	2,600	....
Austria	2,494	4,505	4,946	....	5,922	8,114	14,310	9,000
Spain	....	....	....	....	2,500	2,600	5,964	5,606
United States, West Indies, Australia, Japan, Hawaii, etc.	8,663	2,415	3,642	8,360	3,908	3,493	2,104	2,352
Total	322,871	350,277	360,505	444,675	348,556	424,130	492,610	467,872

[a] A large proportion of the shipments to Rotterdam are forwarded to the interior of Germany.

Total shipments of Florida hard-rock phosphate, 1891–1903.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1891	71,682	1896	322,871	1901	424,130
1892	188,013	1897	350,277	1902	492,610
1893	220,216	1898	360,505	1903	467,872
1894	304,079	1899	444,675		
1895	306,046	1900	348,556		

Shipments of Florida land-pebble phosphate, 1899–1903.

	1899.	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
United Kingdom ports	11,079	2,540	10,596	22,035	29,226
Baltic ports	19,691	19,310	24,518	32,785	40,550
Continental ports	28,711	24,826	26,720	40,942	41,655
Mediterranean ports	28,634	31,980	30,200	34,953	34,630
Other foreign ports	12,620	14,070	19,743	5,046	5,700
Total foreign shipments	100,735	92,726	111,777	135,761	151,761
Total domestic shipments	50,821	124,149	156,649	198,800	157,015
Total shipments	151,556	216,875	268,426	334,561	308,776

Shipments of Florida river-pebble phosphate, 1899–1903.

	1899.	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
United Kingdom ports	35,600	21,427	18,855	4,000	....
Continental ports	2,600	....	....	....	....
Mediterranean ports	2,007	....	....	....	....
Other foreign ports	4,971	....	....	....	....
Total foreign shipments	45,178	21,427	18,855	4,000	....
Total domestic shipments	39,372	33,079	31,828	3,070	66,655
Total shipments	84,550	54,506	50,683	7,070	66,655

SOUTH CAROLINA.

During the year 1903 South Carolina produced (marketed) of land rock, 233,540 long tons, valued at $721,303, as compared with 245,243 long tons, valued at $753,220, in 1902, and of river rock 25,000 long tons, valued at $62,500, as compared with 68,122 long tons, valued at $166,505, in 1902.

The total production (sales) of phosphate rock in the State was 258,540 long tons, valued at $783,803, in 1903, as compared with 313,365 long tons, valued at $919,725, in 1902. The production of phosphate rock in South Carolina has been falling off year by year since 1893 (with the exception of 1898, when there was an increase over the preceding year), until last year the output was but little more than one-half what it was eleven years ago.

The following table shows the production of land and river phosphate rock in South Carolina since 1867, the figures being based on sales for the respective years:

Marketed output of phosphate rock by the land and river mining companies of South Carolina, 1867–1903.

Year ending—	Land companies.	River companies.	Total.	Year ending—	Land companies.	River companies.	Total.
May 31—	*Long tons.*	*Long tons.*	*Long tons.*	Dec. 31—	*Long tons.*	*Long tons.*	*Long tons.*
1867	6	....	6	1885 a	149,400	128,389	277,789
1868	12,262	....	12,262	1886	253,484	177,065	430,549
1869	31,958	....	31,958	1887	261,658	218,900	480,558
1870	63,252	1,989	65,241	1888	290,689	157,878	448,567
1871	56,533	17,655	74,188	1889	329,543	212,102	541,645
1872	36,258	22,502	58,760	1890	353,757	110,241	463,998
1873	33,426	45,777	79,203	1891	344,978	130,538	475,516
1874	51,624	57,716	109,340	1892	243,652	150,575	394,227
1875	54,821	67,969	122,790	1893	308,435	194,129	502,564
1876	50,566	81,912	132,478	1894	307,305	142,803	450,108
1877	36,431	126,569	163,000	1895	270,560	161,415	431,975
1878	112,622	97,700	210,322	1896	267,072	135,351	402,423
1879	100,779	98,586	199,365	1897	267,380	90,900	358,280
1880	125,601	65,162	190,763	1898	298,610	101,274	399,884
1881	142,193	124,541	266,734	1899	223,949	132,701	356,650
1882	191,305	140,772	332,077	1900	266,186	62,987	329,173
1883	219,202	159,178	378,380	1901	225,189	95,992	321,181
1884	250,297	181,482	431,779	1902	245,243	68,122	313,365
1885	225,913	169,490	395,403	1903	233,540	25,000	258,540
				Total	6,935,679	3,955,362	10,891,041

a Seven months.

The quantities and values of the different kinds of phosphate rock produced and marketed in the State since 1897 are shown in the following table:

Quantity and value of phosphate rock produced in South Carolina, 1897–1903, classified by grades.

Year.	Land rock.		River rock.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
1897	267,380	$748,050	90,900	$238,522	358,280	$986,572
1898	298,610	856,225	101,274	251,047	399,884	1,107,272
1899	223,949	738,969	132,701	339,130	356,650	1,078,099
1900	266,186	877,405	62,987	164,565	329,173	1,041,970
1901	225,189	716,101	95,992	245,739	321,181	961,840
1902	245,243	753,220	68,122	166,505	313,365	919,725
1903	233,540	721,303	25,000	62,500	258,540	783,803

TENNESSEE.

The mining of phosphate rock has been carried on in Tennessee for ten years. The output and value of the material at the mines are shown in the following table:

Production of phosphate rock in Tennessee, 1894–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1894	19,188	$67,158	1900	454,491	$1,328,707
1895	38,515	82,160	1901	409,653	1,192,090
1896	26,157	57,370	1902	390,799	1,206,647
1897	128,723	193,115	1903	460,530	1,543,567
1898	308,107	498,392	Total	2,660,272	7,346,366
1899	424,109	1,177,160			

As may be seen from the table, the marketed production of the State for 1903 was 460,530 long tons valued at $1,543,567, as compared with 390,799 long tons, valued at $1,206,647, in 1902. The increase in average value at the mines was from $3.09 per long ton in 1902 to $3.35 per long ton in 1903. The past year seems to have been the most prosperous year known in the history of phosphate-rock mining in Tennessee, since the output was the largest on record, and the average price obtained for the rock was greater than ever before, except during 1894, when the production was very small.

Phosphate rock in stock in the State at the end of 1903 amounted to 5,781 long tons.

The following statement of shipments of Tennessee phosphate rock by water from Pensacola, Norfolk, and Newport News during the last five years has been taken from the reports of Messrs. Auchincloss Brothers. Most of the exports to United Kingdom ports have been to

Manchester. Of continental ports, Antwerp received nearly half of the shipments, Dunkirk nearly one-quarter, and Havre nearly one-eighth. Of the Mediterranean ports, those in Italy received nearly five-sixths of all shipments, while Marseilles received about as much as Havre.

Shipments of Tennessee phosphate from Pensacola, Norfolk, and Newport News, 1899–1903.

	1899.	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
United Kingdom ports	28,185	8,080	10,217	11,701	10,374
Baltic ports	2,758				
Continental ports	63,156	55,221	56,639	35,111	31,956
Mediterranean ports	66,382	69,014	58,309	56,106	66,935
Other foreign ports	2,100				
Total foreign shipments	162,581	127,815	125,165	102,918	109,265
Total domestic shipments	10,212				2,650
Total shipments	172,743	127,815	125,165	102,918	111,915

OTHER STATES.

North Carolina and Arkansas are the only other States reporting production of phosphate rock during 1903. The former reports but 45 long tons of high-grade rock, valued at $500. The latter reports a marketed production of 2,125 long tons, valued at $4,600, as compared with 550 long tons, valued at $1,650, in 1902. Furthermore, 2,200 long long tons of rock were in stock in Arkansas at the end of the year 1903.

PRICES.

During 1903 the average price of phosphate rock per long ton obtained at the mines, based on the returns given in the preceding tables, was: Florida, hard rock, $4.81 per long ton. In 1902 this grade averaged $4.06, and it brought $5.23 in 1901, $5.25 in 1900, $4.60 in 1899, and $3.81 in 1898. Land pebble averaged $2.27 per long ton at the mines in 1903. This grade has continuously decreased in average price for the last five years, the price obtained having been $2.91 in 1899, $2.77 in 1900, $2.67 in 1901, and $2.32 in 1902, but the price has not yet declined to $1.89, which was received in 1898. River pebble averaged $2 in 1903, whereas it averaged $1.92 per long ton in 1902 and $2.25 in 1901.

In South Carolina the average price per long ton received for land rock in 1903 was $3.09. In 1902 the average price was $3.07; in 1901, $3.18; in 1900, $3.30; in 1899, $3.30; and in 1898, $2.87. River rock shows a falling off in the average price obtained at the mines, only $2.50 per long ton being realized in 1903, as compared with $2.44 in 1902, $2.56 in 1901, $2.61 in 1900, $2.56 in 1899, and $2.48 in 1898.

In Tennessee the average price realized at the mines for phosphate rock has increased steadily since 1897, with the exception of a slight check in 1901. The average price per long ton in 1903 was $3.35, free on board at the mines. The average prices obtained in recent previous years have been: 1897, $1.50; 1898, $1.62; 1899, $2.77; 1900, $2.92; 1901, $2.91; and 1902, $3.09.

IMPORTS.

The following table shows the imports of fertilizers of all kinds into the United States from 1868 to 1903, inclusive:

Fertilizers imported and entered for consumption in the United States, 1868–1903.

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	1,437,442	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	20,984	393,039	40,068	611,284	1,004,323
Dec. 31—					
1886	18,520	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	4,642	59,580	81,191	252,787	312,367
1891	11,987	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	80,068	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	24,439	140,940	230,142
1902	8,393	164,783	57,558	388,479	553,262
1903	21,985	252,132	141,060	733,192	985,324

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, 183,472 ($777,602); 1900, long tons, 181,353 ($1,201,272); 1901, long tons, 240,937 ($1,360,619); 1902, long tons, 225,413 ($1,016,082); 1903, long tons, 158,318 ($778,758).

WORLD'S PRODUCTION.

In the following table will be found a statement of the world's production of phosphate rock from 1896 to 1902, inclusive:

World's production of phosphate rock, 1896–1902.

[Metric tons.]

Country.	1896.		1897.		1898.		1899.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Algeria	165,738	$500,905	228,141	$912,564	269,500	$1,078,000	324,983	$1,299,932
Belgium	[a]297,470	537,320	[a]350,056	436,762	[a]156,920	303,230	[a]190,090	342,180
Canada	517	3,420	824	3,984	665	3,665	2,722	18,000
France	582,667	3,502,027	535,390	2,852,887	568,558	3,115,958	645,868	3,334,145
Norway	1,106	17,280	872	12,960	3,593	53,352	1,500	22,140
Redonda (Br. West Indies)	....	....	812	5,525	750	4,725	1,507	9,270
Russia	3,776	11,065	5,917	22,132	1,870	4,784	16,863	58,640
Spain	770	3,080	2,084	16,672	4,500	46,003	8,510	35,100
United Kingdom	3,048	26,250	2,032	17,500	1,575	13,565	1,469	12,645
United States	945,982	2,803,372	1,056,322	2,673,202	1,380,264	3,453,460	1,540,506	5,064,076

Country.	1900.		1901.		1902	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Algeria	319,422	$1,277,688	265,000	$1,060,000	305,174	$1,220,696
Belgium	[a]215,670	367,164	222,520	361,898	135,850	297,848
Canada	1,284	7,105	937	6,280	776	4,969
France	587,919	2,827,291	535,676	2,614,543	548,900	2,480,454
Norway	300	4,445	(b)	....	(b)	....
Redonda (Br. West Indies)	2,230	13,720	Nil.	....	132	791
Russia	25,663	(c)	(b)	....	(b)	....
Spain	4,170	18,590	4,220	16,880	1,150	4,600
Tunis	....	....	....	....	264,960	1,075,616
United Kingdom	630	5,425	71	680	87	582
United States	1,515,179	5,359,248	1,507,548	5,316,403	1,514,254	4,693,444

[a] Cubic meters.
[b] Statistics not yet available.
[c] Value not reported.

SALT.

By Edmund Otis Hovey.

PRODUCTION.

The reported production of salt in the United States during 1903 amounted to 18,968,089 barrels (of 280 pounds), valued at $5,286,988, as compared with 23,849,231 barrels, valued at $5,668,636, in 1902. The production is the least in quantity reported since 1898, but the average price per barrel obtained is greater than it was in 1902, though not so great as it was in 1901 and previous years. For convenience salt is classified in this table into "table," "common fine," "common coarse," "packers," "solar," "rock," "milling," and "other grades." The last-named division embraces products not properly included among the preceding, and it includes salt in the form of brine, which is used in large quantities for the making of soda ash, sodium bicarbonate, sodium hydrate (caustic soda), and other sodium salts.

The following table shows the distribution of the total salt production of the United States by grades during the last eleven years. From this table it will be seen that the falling off in 1903 from the total of preceding years is due to the decrease of nearly 6,000,000 barrels in the reported production of salt referred to as "other grades."

Production of salt, by grades, in the United States, 1893–1903.

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	108,041	587,305
1895	2,173,123	6,099,480	280,284	118,801	983,870
1896	2,230,409	6,598,733	300,365	163,085	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	2,027,796	6,692,587	1,571,137	466,987	1,172,484
1903	2,441,906	6,351,855	1,829,460	270,170	1,743,101

Production of salt, by grades, in the United States, 1893–1903—Continued.

Year.	Rock.	Milling.	Other grades.	Total production.	Total value.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	
1893	1,884,145	5,141	6,418	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	183,271	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	17,612,684	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	5,008,526	20,566,661	6,617,449
1902	2,889,836	127,521	8,900,881	23,849,231	5,668,636
1903	3,175,521	37,657	3,118,417	18,968,089	5,286,988

The total annual production of salt in the United States since 1880 is given in the subjoined table, which shows that in proportion to 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 are available and in part to the fact that the value of the product as 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, 1880–1903.

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	23,849,231	5,668,636
1891	9,987,945	4,716,121	1903	18,968,089	5,286,988

The chief salt-producing States are New York and Michigan, and the combined output from these two States in recent years has amounted to from two-thirds to three-fourths of the total production of the United States. As will be seen from the following table, the four leading salt-producing States during 1903 were New York, 8,170,648 barrels (43.1 per cent); Michigan, 4,297,542 barrels (22.6 per cent); Ohio, 2,798,899 barrels (14.7 per cent), and Kansas, 1,555,934 barrels

(8.2 per cent). These four States contributed 88.6 per cent of the total quantity of salt produced in the country during the year. The reported production of Michigan is 3,834,239 barrels less than in 1902, many firms having closed their plants or gone out of the business during 1903.

Production of salt, by States and Territories, during 1900, 1901, 1902, and 1903.

State or Territory.	1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*		*Barrels.*		*Barrels.*	
New York	7,897,071	$2,171,418	7,286,320	$2,089,834	8,523,389	$1,938,539	8,170,648	$2,007,807
Michigan	7,210,621	2,083,731	7,729,641	2,437,677	8,131,781	1,535,823	4,297,542	1,119,984
Kansas	2,233,878	1,076,945	2,087,791	614,365	2,158,486	514,401	1,555,984	564,282
Ohio	1,425,283	696,326	1,153,535	455,924	2,109,987	593,504	2,798,899	795,897
California	621,857	216,291	601,659	133,656	682,660	253,085	629,701	198,630
Texas	(a)	(a)	(a)	(a)	347,906	143,683	314,000	117,647
West Virginia	243,878	118,407	231,722	94,732	208,592	97,721	244,236	85,797
Utah	249,128	151,662	384,494	326,016	417,501	270,626	212,955	181,710
Louisiana	(a)	(a)	(a)	(a)	(a)	(a)	568,936	178,342
Other States	987,631	479,823	1,141,509	465,245	1,268,929	321,254	175,238	86,942
Total	20,869,342	6,944,603	20,566,661	6,617,449	23,849,231	5,668,636	18,968,089	5,286,988

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 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 94.1 per cent in 1903, while the consumption of salt imported into the United States decreased from 36.5 per cent of the total in 1880 to 5.9 per cent in 1903. The actual consumption in 1903 was 20,062,587 barrels, or about 2.14 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 1903 show an increase to 18,968,089 barrels of domestic salt produced, while the imports decreased to 1,185,578 barrels.

Supply of salt for domestic consumption, 1880–1903.

[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, 1880–1903—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	8,056,565	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	a305,981	a399,186	827,610	968,686
Percentage of imports to total consumption	21.7	18.5	17.2	14.5

Source.	1892.	1893.	1894.	1895.
Domestic production	11,698,890	11,897,208	12,968,417	13,669,649
Imports	1,633,419	1,244,711	1,550,555	1,996,970
Total	13,332,309	13,141,919	14,518,972	15,666,619
Exports	18,603	20,686	38,763	36,855
Domestic consumption	13,313,706	13,121,233	14,480,209	15,629,764
Increase over preceding year	1,647,602	a192,473	1,358,976	1,149,555
Percentage of imports to total consumption	12.3	9.49	10.71	12.78

Source.	1896.	1897.	1898.	1899.
Domestic production	13,850,726	15,973,202	17,612,634	19,708,614
Imports	1,858,614	1,493,033	1,325,212	1,350,366
Total	15,709,340	17,466,235	18,937,846	21,058,980
Exports	63,391	54,195	61,715	90,000
Domestic consumption	15,645,949	17,412,040	18,876,131	20,968,980
Increase over preceding year	16,185	1,766,091	1,464,091	2,092,849
Percentage of imports to total consumption	11.88	8.57	7.02	6.4

a Decrease.

Supply of salt for domestic consumption, 1880–1903—Continued.

Source.	1900.	1901.	1902.	1903.
Domestic production	20,869,342	20,566,661	23,849,231	18,968,089
Imports	1,427,921	1,440,950	1,319,744	1,185,578
Total	22,297,263	22,007,611	25,168,975	20,153,657
Exports	53,650	67,376	36,386	91,070
Domestic consumption	22,243,613	21,940,235	25,132,589	20,062,587
Increase over preceding year	1,274,633	[a]303,378	3,192,354	[a]5,070,002
Percentage of imports to total consumption	6.4	6.6	5.3	5.9

[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 up to that time 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 and to 403,465,946 pounds in 1901, and decreased to 369,528,186 pounds in

1902 and to 331,961,807 pounds in 1903. Since 1867 the imports have been as follows:

Salt imported and entered for consumption in the United States, 1867–1903.

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	306,446,080	915,546	219,975,096	365,458
1869	297,382,750	895,272	256,765,240	351,168
1870	288,479,187	797,194	349,776,433	507,874
1871	283,993,799	800,454	274,730,578	355,318
1872	258,282,807	788,893	257,687,230	312,569
1873	239,494,117	1,254,818	388,012,132	625,565
1874	358,375,496	1,452,161	427,294,209	649,838
1875	318,673,091	1,200,541	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	582,831
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	1,098,628	441,613,517	433,827
1885	351,276,969	1,090,029	412,822,341	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
1888	238,921,421	620,425	272,650,231	246,022
1889	180,906,293	627,184	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	224,569
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	1,627,090	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	118,480,798	422,304	151,169,362	138,552
1903	72,838,011	259,029	151,635,246	134,714

Salt imported and entered for consumption in the United States, 1867–1903—Continued.

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	64,671,189	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	110,294,440	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	1,733,569
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	133,895,065	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
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	634,307
1901	115,257,757	96,625	....	....	403,165,946	676,324
1902	99,878,031	86,698	....	....	369,528,186	647,551
1903	107,487,450	102,205	....	....	331,961,807	495,948

Salt of domestic production exported from the United States, 1790–1903.

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	239,936
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	16,278
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	42,065	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	26,436
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	33,375
1856	698,458	311,495	1894	10,853,759	46,780
1857	576,151	190,699	1895	7,203,024	30,989
1858	533,100	162,650	1896	10,711,314	43,202
1859	717,257	212,710	1897	11,593,321	52,330
1860	475,445	129,717	1898	17,280,198	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	1903	25,499,630	95,570

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, 1901, 1902, and 1903. 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 Japan, the Central American States, and Asiatic Russia, about 46.8 per cent of the exports having taken this route in 1903. During the same period 47 per cent of the exports of salt was shipped 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, 1901, 1902, and 1903.

Country from which imported.	Year ending June 30, 1901.		Year ending June 30, 1902.		Year ending June 30, 1903.	
	Dutiable and free.		Dutiable and free.		Dutiable.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
United Kingdom	165,659,476	$447,012	151,316,042	$488,652	113,828,493	$349,509
Italy	86,370,630	46,391	90,826,888	61,137	76,360,106	53,011
Canada	5,865,395	13,821	8,721,684	25,245	8,884,424	26,697
West Indies	135,477,860	118,118	119,448,756	102,964	131,253,695	113,578
Other countries	14,551,271	11,425	11,561,475	10,371	11,816,828	22,171
Total	407,924,632	636,767	381,874,845	688,369	342,143,546	564,966

Exports of salt during the fiscal years ending June 30, 1901, 1902, and 1903.

Country to which exported.	Year ending June 30, 1901.		Year ending June 30, 1902.		Year ending June 30, 1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
United Kingdom	11,950	$213	22,000	$500	95,500	$450
Bermuda	155,825	1,619	196,368	1,874	161,248	1,655
British Honduras	10,260	151	13,891	96	15,608	168
Dominion of Canada:						
Nova Scotia, New Brunswick, etc	31,115	705	74,680	1,133	63,550	648
Quebec, Ontario, etc	2,413,357	6,301	5,073,350	10,761	5,955,665	18,379
British Columbia	2,509,484	10,513	2,267,235	14,030	1,801,030	8,170
Newfoundland and Labrador	104,011	946	67,140	696	49,500	476
Central American States:						
Costa Rica	141,188	1,821	139,980	1,610	142,661	1,449
Guatemala	371,634	1,903	476,287	2,888	78,528	581
Honduras	165,408	1,354	60,215	706	99,532	827
Nicaragua	332,063	2,942	346,913	2,913	411,767	3,463
Salvador	....	....	....	....	75,558	485
Mexico	1,177,080	10,273	1,728,915	15,873	1,297,004	11,642
West Indies:						
British	188,341	1,882	158,875	658	82,199	408
Danish	1,300	16	2,000	26	1,650	25
French	11,613	155	14,102	171	15,887	216
Haiti	4,897	68	3,348	50	6,475	77
Santo Domingo	38,226	485	24,902	336	34,286	462
Cuba	357,095	1,868	62,965	386	39,699	317
Colombia	173,875	2,018	189,786	1,694	207,810	2,240
Japan	1,485,430	5,061	454,665	1,546	5,413,425	15,126
China	40	1	....	....	1,810	25
Russia, Asiatic	3,585,300	12,236	5,608,750	23,104	182,210	1,119
French Oceania	158,075	700	75,348	811	118,800	1,098
British Australasia	459,916	3,690	215,600	949	2,850	22
Philippine Islands	....	....	....	....	960	13
British Africa	8,785	88	400	8	10,600	67
Other countries	336,899	1,812	43,453	435	80,908	735
Total	14,183,167	67,316	17,321,168	83,249	16,446,380	70,296

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 1902. 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. The increase in the production of salt in the United States during 1902 amounted to 461,959 short tons, while the production of Great Britain decreased nearly 124,000 short tons. 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 1902 was 44 per cent greater than that of Great Britain for that year.

In 1899 the production of salt in Great Britain increased over that of the preceding year for the first time since 1894, though it fell off again in 1900, whereas the production of salt in the United States has increased annually from 1890 to 1900. The table further shows that the United States produced in 1902 about 24 per cent of the reported world's supply, and that Great Britain produced about 15 per cent. The latest statistics available for Russia are for the calendar year 1901, when the production was about 14 per cent of the total; Germany's production in 1902 was 12 per cent of the total; France produced 7.1 per cent, India about 8.5 per cent, and Austria-Hungary about 4.2 per cent. It is noticeable, however, that while the production of Austria-Hungary was less than 5 per cent of the world's total output the value of the product in that country was almost 40 per cent of the total value of the world's production. This is due to the fact that the salt-producing industry of Austria-Hungary is a Government monopoly and one of its principal sources of revenue. The production of salt in Austria-Hungary in 1902 was about one-fifth the production in the United States, but the value of the salt product of the United States was very little more than one-third of the value of the product of Austria-Hungary. The first cost of salt to the consumer in the United States is less that $2 per ton; in Austria-Hungary it is nearly $28 per ton, and with such conditions the small production is readily accounted for. The mere fact that salt is so cheaply produced in Great Britain and in the United States has increased its consumption and has had no little influence in the development of the packing industries, the manufacture of hydrochloric acid, chlorine, and sodium salts, and also in the development of the chlorination process for the extraction of gold from its ores and of the wet processes for the treatment of silver ores.

In the following table the statistics of salt production in the principal countries of the world are shown for each year from 1890 to 1902, with the exception of Russia and Japan, where the latest statistics available are for 1901. The production of salt in Turkey is not included. The industry in that country, as in Austria-Hungary, is a Government monopoly and no statistics of production are published. For the sake of convenience the quantities are expressed in short tons.

The world's salt production, 1890–1902.

Year.	United States. Quantity.	United States. Value.	United Kingdom. Quantity.	United Kingdom. Value.	France.[a] Quantity.	France.[a] Value.	German Empire. Quantity.	German Empire. 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	2,504,221	3,703,601	1,001,498	2,762,216	1,381,211	4,353,707
1895	1,913,751	4,423,084	2,434,043	3,442,292	988,273	2,421,378	1,332,557	4,396,161
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	2,144,680	3,134,873	1,334,962	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
1902	3,339,891	5,668,636	2,121,126	2,886,665	982,479	2,605,800	1,745,226	4,992,600

Year.	Japan. Quantity.	Japan. Value.[c]	Italy. Quantity.	Italy. Value.	Austria-Hungary.[b] Quantity.	Austria-Hungary.[b] 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	$3,862,930	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	761,575	4,459,245	479,706	668,982	569,725	15,556,431
1902	(d)	(d)	505,401	711,400	575,936	16,071,930

Year.	Russia. Quantity.	Russia. Value.	Spain. Quantity.	Spain. Value.	India. Quantity.	India. Value.
	Short tons.		*Short tons.*		*Short tons.*	
1890	1,531,736	$2,618,611	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	(f)	495,965	834,535	1,125,611	1,146,363
1901	1,913,696	(f)	380,363	599,934	1,234,839	1,821,764
1902	(e)	(f)	470,057	707,424	1,165,291	1,554,914

[a] Includes product of Algeria. [b] Government monpoly. [c] No value obtainable.
[d] Production and value in 1901 used in making up the total for the world's production in 1902.
[e] Production in 1901 used in making up total for the world's production in 1902.
[f] Unit value taken the same as in 1899 in making up the total for the world's production for 1900, 1901, and 1902.

The world's salt production, 1890–1902—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	13,555,298	45,631,732
1902	63,056	288,581	[g] 125,467	970,522	13,769,201	43,684,935

[a] Not including production of Japan prior to 1899, 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 quanity 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.
[g] In addition there were produced probably 1,000,000 short tons in various countries for which no definite statistics are available.

SULPHUR AND PYRITE.

By Joseph Hyde Pratt.

INTRODUCTION.

The most noticeable change in the sulphur and pyrite industries during the last year is the increase in the consumption of pyrite and the very large increase in the use of pyrite as a substitute for sulphur, especially in the manufacture of sulphuric acid. The reasons for these conditions will be found in the recent advance in prices of sulphur, brought about through the agreement made between the Anglo-Sicilian Sulphur Company and the mines in Sicily, by which this company controls at least 85 per cent of the total production of sulphur in Sicily. The natural result of such a control of the industry has been an increase in the prices of sulphur, which has had a decided influence in increasing the production and consumption of pyrite.

The greater portion of the world's supply of natural sulphur is obtained from Sicily, and of this production the United States consumes by far the larger amount. The chief uses of the sulphur imported into the United States are for industrial purposes, as in the manufacture of sulphuric acid and in the paper trade, while that used in France and Italy is for agricultural purposes. The increase in the price of Sicilian sulphur has both stimulated the manufacture of sulphuric acid from pyrite, thus greatly increasing the production of this mineral, and it is also beginning to cause a substitution of pyrite for the natural sulphur used in the manufacture of paper pulp. In a few instances in this country sulphite-paper mills are obtaining their sulphurous acid from smelter works that are conveniently located near by, which are roasting pyritic ores. It will undoubtedly be found economical in some cases to change the pulp-mill plants so that they can burn pyrite instead of sulphur. This has already been done by three of the largest pulp mills in Germany and Sweden.[a]

Up to the present time the largest increase in the production of pyrite and its use in the place of sulphur has been in the manufacture

[a] Schnatterbeck, C. C., Eng. and Min. Jour., Sept. 5, 1903.

of sulphuric acid for the fertilizer trade and for refining petroleum. It has been estimated that the production of pyrite has increased 141 per cent and the imports 132 per cent since 1895, the year before the Anglo-Sicilian Sulphur Company was organized and obtained control of most of the Sicilian sulphur output. During this same time the imports of natural sulphur have only increased 43.5 per cent; while the production of natural sulphur in the United States has increased 363 per cent. These large increases in the domestic production of pyrite and sulphur and the importation of pyrite are, of course, partly due to the general increase in the demand for these minerals, but their exceptionally large increase as compared with the imports of natural sulphur is due, as stated above, to the general advance in the price of Sicilian sulphur.

Another effect has been to stimulate prospecting for both sulphur and pyrite deposits in the United States, which has resulted successfully in some cases. It has also encouraged the investment of American capital in prospecting and developing sulphur deposits in Mexico, and the introduction of pyrite from British Columbia into the American market. With sulphur as contraband goods in time of war it is essential that the United States should be able to obtain supplies of this mineral at short notice and have a reserve supply within its own boundaries, and this is another reason for the more thorough prospecting for deposits of this mineral in the United States, Alaska, and Mexico.

SULPHUR.

PRODUCTION.

The production of sulphur and of pyrite for the manufacture of sulphuric acid in the United States during 1903 was 233,127 long tons, valued at $1,109,818, as compared with a production of 207,874 long tons, valued at $947,089, in 1902, an increase of 25,253 long tons in quantity and of $162,729 in value. The States producing the sulphur were Louisiana, Nevada, and Utah, given in the order of the importance of their production. The actual production of sulphur in 1903 was a few tons less than in 1902, and is very small as compared with the quantity imported.

The following table shows the annual production of sulphur in the United States from 1880 to 1903:

Sulphur production of the United States, 1880–1903.

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	1903	(a)	(a)

[a] See table of pyrite production on page 26.

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 segregate 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. Any 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, a total of 211,491 long tons. In 1903 the domestic production of sulphur and the sulphur content of the domestic production of pyrite amounted to 108,967 long tons. In this same year the sulphur content of the net imports of pyrite amounted to 189,184 long tons, and the natural sulphur imported was 191,033 long tons—a total of 380,217 long tons of imported sulphur consumed in the United States. The total domestic consumption of sulphur in 1903 was therefore 489,184 long tons, as compared with 469,361 tons in 1902, an increase of 19,823 tons.

The statistics for the years 1893 to 1903, inclusive, of the production and importation of sulphur, and of the sulphur content of domestic and imported pyrite, which, taken together, constitute the total domestic consumption, are presented in the following tables:

Estimated consumption of sulphur in the United States, 1893–1901.

Source.	1893.	1894.	1895.	1896.	1897.
Sulphur:	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Domestic	1,071	446	1,607	4,696	2,061
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	64,449
Imported	87,715	74,596	85,796	90,076	116,796
Total domestic consumption	228,709	248,174	254,196	286,020	325,172

Source.	1898.	1899.	1900.	1901.
Sulphur:	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Domestic	1,071	4,300	3,147	6,866
Imported [a]	164,504	141,533	167,696	175,210
Sulphur content of pyrite: [b]				
Domestic	87,014	78,630	92,077	105,671
Imported	113,748	121,441	145,118	181,668
Total domestic consumption	366,337	345,904	408,038	469,415

[a] Includes crude sulphur, flowers of sulphur, refined sulphur, and sulphur lac.
[b] Based on average sulphur content of 45 per cent.

Estimated consumption of sulphur in the United States in 1902 and 1903.

Source.	1902.	1903.
	Long tons.	*Long tons.*
Domestic sulphur and sulphur content of pyrite	97,636	108,967
Imported sulphur	174,939	191,033
Sulphur content of imported pyrite	196,786	199,184
Total domestic consumption	469,361	499,184

PRODUCTION OF SULPHUR IN ITALY.

As most of the sulphur imported into the United States is obtained from Italy, it will be of some interest to know the yearly production of this mineral in that country. In the following table the statistics of the quantity and value of the sulphur produced in Italy since 1860 (practically all of which is obtained from the island of Sicily) are taken from the official report Rivista del Servizio Minerario:

Production of sulphur in Italy in 1860–1902.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1860	155,067	$3,698,036	1882	438,751	$9,002,010
1861	163,217	3,865,950	1883	439,332	8,161,887
1862	162,825	3,872,376	1884	404,431	7,048,751
1863	179,637	4,273,992	1885	418,708	6,748,077
1864	177,707	4,134,870	1886	368,827	5,896,720
1865	168,829	3,756,507	1887	336,715	4,572,979
1866	195,019	4,579,547	1888	370,486	4,827,512
1867	195,873	4,641,046	1889	365,524	4,758,005
1868	198,097	4,822,158	1890	363,305	5,455,201
1869	197,493	5,071,715	1891	389,171	8,593,413
1870	200,597	4,702,716	1892	411,828	7,569,781
1871	196,518	4,869,515	1893	410,958	5,716,018
1872	235,323	5,746,251	1894	399,260	4,876,715
1873	269,794	6,566,050	1895	364,807	3,989,877
1874	247,221	6,813,675	1896	419,501	5,919,554
1875	204,086	5,562,575	1897	488,676	8,680,800
1876	271,605	6,372,385	1898	494,278	9,368,268
1877	256,141	5,184,313	1899	554,638	10,392,415
1878	300,238	5,896,665	1900	535,522	10,212,903
1879	370,268	7,040,165	1901	572,106	10,734,192
1880	353,883	7,087,859	1902	656,372	12,702,090
1881	367,163	8,088,237			

EXPORTS OF SULPHUR FROM SICILY.

It may be found of interest to consider in connection with the foregoing statistics the following table, which gives the exports of sulphur from Sicily for the years 1896 to 1903, inclusive. This table, as also the four tables following, has been compiled from the annual statement published by Mr. Alfred S. Malcomson, of New York.

Total exports of sulphur from Sicily, 1896–1903.

Country.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
	Long tons.	*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	157,068
France	76,739	84,895	88,657	96,043	103,647	74,394	67,634	76,076
Italy	54,009	73,052	62,652	87,230	101,073	74,516	45,601	45,576
United Kingdom	21,913	24,520	26,983	25,038	23,973	22,464	25,475	19,209
Greece and Turkey	18,556	13,866	24,808	18,656	19,647	21,702	20,499	22,168
Portugal	12,001	7,054	8,257	12,269	10,987	11,335	12,842	18,324
Russia	18,752	17,532	12,285	19,211	22,090	15,110	17,294	15,068
Germany	15,680	19,721	27,048	26,933	28,702	28,448	25,908	32,569
Austria	13,799	15,993	15,796	18,519	21,594	18,842	19,085	17,925
Spain	5,910	4,039	3,283	7,757	6,187	2,979		
Belgium	7,527	9,253	8,402	7,481	9,721	7,471	12,322	14,310
Holland	3,834	3,599	5,646	6,408	18,595	10,848	8,648	5,160
Sweden, Norway, and Denmark	14,540	11,226	12,331	12,476	22,681	24,486	24,918	28,290
Other countries	8,562	7,651	12,791	13,569	6,810	9,887	18,171	23,680
Total	396,745	410,538	447,324	479,081	558,162	462,299	467,317	475,423

The table following gives the total quantity of sulphur exported from Sicily since 1883:

Total exports of sulphur from Sicily, 1883–1903.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1883	335,392	1890	344,763	1897	410,538
1884	314,058	1891	293,323	1898	447,324
1885	314,582	1892	309,536	1899	479,081
1886	329,446	1893	349,192	1900	558,162
1887	311,302	1894	328,930	1901	462,299
1888	347,775	1895	347,636	1902	467,317
1889	351,451	1896	396,745	1903	475,423

IMPORTS.

The sulphur imported into the United States is produced principally in Sicily and Japan, with very small quantities in Mexico and Chile. The following table shows the quantity and value of the sulphur imported into the United States for each year since 1867:

Sulphur imported and entered for consumption in the United States, 1867–1903.

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	......	50,006	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	12,009	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
1903	188,990	3,649,756	1,854	52,680	160	3,746	28	3,508	3,709,690

[a] Includes sulphur lac and other grades not otherwise provided for, but not pyrite.

In the next table are given the statistics of imports by countries from which the sulphur was exported to the United States and by ports at which it was received during the fiscal years 1900 to 1903, inclusive.

Canada and England, given as exporting countries, did not produce any sulphur, but were the countries from which it was exported to the United States.

Statement, by countries and by customs districts, showing the imports into the United States of crude sulphur or brimstone each fiscal year, 1900–1903.

Countries whence exported and customs districts through which imported.	1900.		1901.	
	Quantity.	Value.	Quantity.	Value.
COUNTRY.	*Long tons.*		*Long tons.*	
Canada			933	$24,957
England	7,425	$155,882	7,484	156,205
Italy	138,011	2,369,037	139,492	2,474,684
Japan	9,958	186,847	11,798	219,193
Other countries	5	146	4	65
Total	155,399	2,711,912	159,711	2,875,104
DISTRICT.				
Baltimore, Md	12,798	213,893	9,040	153,664
Boston and Charlestown, Mass	10,023	203,014	11,048	217,274
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	1,565,084
Philadelphia, Pa	7,448	120,284	11,100	185,319
Portland, Me	24,880	436,692	20,039	363,473
San Francisco, Cal	8,237	152,835	9,359	172,176
Savannah, Ga	751	13,675	1,000	18,190
Vermont, Vt			439	12,285
Willamette, Oreg	1,630	33,134	2,087	40,515
All other	2,747	54,827	3,630	72,430
Total	155,399	2,711,912	159,711	2,875,104

Countries whence exported and customs districts through which imported.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
COUNTRY.	*Long tons.*		*Long tons.*	
Canada	776	$18,631		
England	7,681	161,387	10,060	214,456
Italy	163,571	3,111,971	153,782	2,997,908
Japan	15,448	290,826	16,167	315,833
Other countries	4	69	1,121	21,173
Total	187,480	3,582,884	181,130	3,549,370
DISTRICT.				
Baltimore, Md	12,137	225,804	11,984	232,780
Boston and Charlestown, Mass	12,124	251,366	14,362	303,548
Champlain, N. Y				
New Orleans, La			609	19,889
New York, N. Y	100,109	1,891,554	98,855	1,917,523
Philadelphia, Pa	16,719	304,777	11,635	219,061
Portland, Me	30,032	596,931	26,559	522,291
San Francisco, Cal	10,497	200,255	10,523	208,589
Savannah, Ga				
Vermont, Vt				
Willamette, Oreg	3,475	63,696	4,151	76,283
All other	2,387	48,501	2,452	49,496
Total	187,480	3,582,884	181,130	3,549,370

WORLD'S PRODUCTION.

World's production of sulphur for 1899, 1900, 1901, and 1902.

Country.	1899.		1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Metric tons.		*Metric tons.*		*Metric tons.*		*Metric tons.*	
United States	4,383	$107,500	3,199	$88,100	6,976	$223,430	(a)	....
Austria[b]	555	1,526	862	2,256	4,911	12,107	3,721	$18,121
France[b]	11,744	28,884	11,551	26,427	7,000	16,400	8,000	18,914
Germany	1,663	36,000	1,445	31,000	963	20,250	....	....
Greece	1,237	22,266	891	16,038	3,212	67,290	1,391	24,162
Hungary	116	3,600	123	3,820	137	3,847	105	2,947
Italy	554,638	10,892,415	544,119	10,212,903	563,096	10,734,192	[b] 3,581,671	8,131,732
Japan	10,235	211,735	14,435	155,932	16,578	192,465	(c)	....
Russia	451	9,412	1,587	....	(c)	....	(c)	....
Spain	1,100	31,350	750	18,000	610	13,115	....	....
	[b] 58,922	102,150	[b] 64,364	[b] 109,947	[b] 49,856	57,236	[b] 15,442	38,736
Sweden	....	....	70	1,890	Nil.	....	74	1,983
Total	645,044	10,946,888	643,396	10,666,318	653,339	11,340,332	3,610,404	8,236,595

[a] Included with pyrite. [b] Crude rock. [c] Statistics not yet reported.

PYRITE.

SOURCES OF SUPPLY.

There are many localities throughout the United States where pyrite occurs in quantity, but owing to their distance from railroad or water transportation facilities they are not of commercial importance at the present time. Such deposits are known in Tennessee, North Carolina, Georgia, New York, and in many of the Western States. The larger quantity of the pyrite produced in the United States is obtained from Virginia, the mines being located in Louisa and Prince William counties. Massachusetts, Alabama, Ohio, and California are also producers of pyrite in some considerable quantity. The pyrite that is produced in Ohio and Indiana is obtained as a by-product in coal mining and is known as "coal brasses."

The Wikel pyrite mine near Hot Springs, Ark., owned by Dr. J. B. Gebhart, has recently been optioned to an Alabama company, which is to develop the property thoroughly. The vein has been traced for a distance of 3,000 feet, and the vein of solid pyrite 1½ inches wide at the surface has increased to 15 inches at the depth of 20 feet, the present depth of the shaft. This seam is a part of the main fissure that is about 75 feet wide and is filled mostly with quartz and particles of pyrite.

Another source of supply of sulphur for the manufacture of sulphuric acid that may become a commercial possibility when it is not essential to have an absolutely pure sulphuric acid, is the utilization of the by-product gases obtained in roasting and smelting sulphide ores.

Pyrrhotite ores, although containing considerable less sulphur than pyrite, may become a source of sulphur for the manufacture of sulphuric acid, if the sulphur in the ore can be so effectually removed that the residual oxides can be utilized in the manufacture of iron or steel. The residue from the pyrite ores might be used for this same purpose if the sulphur were driven off sufficiently, but usually there is a considerable percentage of sulphur remaining in the residue after treatment in the chemical works. In certain places in Spain, from which the United States imports a large amount of pyrite, the residue from the manufacture of sulphuric acid is used in the manufacture of steel.

The domestic production of pyrite does not begin to equal the demand, and the rest of the supply used in the United States is imported, principally from Spain, with smaller quantities from British Columbia, Canada, and Newfoundland.

The chief reason why so many extensive pyrite deposits are not producers is the low price at which pyrite can be had on the market, due to the importation of Spanish pyrite at a figure often less than the cost of putting the American ore on board the cars at the shipping point.

There is an increasing demand for pyrite and allied ores, and this demand will be still further increased as the manufacturers of paper stock by the sulphite process adopt pyrite as a base for their manufacture of sulphurous acid instead of natural sulphur. Satisfactory results can be obtained by digesting the wood pulp with sulphurous-acid gas under pressure instead of with the acid sulphite of calcium and magnesium; and as this gas can be made cheaply by roasting pyrite, and as it is especially cheap when obtained as a by-product gas from smelting works its use instead of sulphur should cheapen the process.

In a recent paper on acid making from pyrrhotite,[a] by Mr. Ernest Sjöstedt, of Sault Ste. Marie, Ontario, Canada, a description is given of the method used in roasting Sudbury pyrrhotite ores and of the utilization of the sulphurous-acid gas given off. Pyrrhotite used had the general formula Fe_6S_7, and contained 15 to 20 per cent sulphur, 1 to 3 per cent nickel, and 0.5 to 2 per cent copper, the remainder being principally iron. By concentration a product was obtained containing about 28 per cent sulphur, 3 per cent nickel, 0.5 per cent copper, and 50 per cent iron. The roasting of this ore, which was in powdered form, was accomplished in a modified Herreshoff furnace. The modifications of this furnace consisted in:

(1) Minimizing the heat of radiation; (2) application to best advantage of the roasting heat generated; (3) exclusion of all the extraneous air possible; (4) the application of an auxiliary heat supply in case of need. These points were practiced as follows: (1) The combination of four single furnaces in one battery, disposed equidistant from a common center; (2) a minimum distance between the floor and roof arch; (3) a round rabble arm, with a secure locking device to prevent inflow of

[a] Canadian Min. Rev., April, 1904; Jour. Amer. Chem. Soc., July, 1904, p. 305.

air, the air for combustion being admitted through special pipes, provided with valves; (4) separate muffle chambers for the auxiliary heat. Four batteries of kilns have been built (16 units) with a total capacity of 40 tons of ore a day and a crushing plant of one 24-inch by 15-inch jaw mill, and two 36-inch rolls to pulverize 80 tons of ore per shift of ten hours; also, two Dellwick-Fleischer No. 4 water-gas generators, each with a capacity of producing 20,000 cubic feet of water gas per hour; also, three 95-horsepower general electric motors for supplying the required power.

The roasting gas.—Water gas was at first used for auxiliary heating, but by care it was found unnecessary, even when the sulphur fell to from 20 to 25 per cent, to give gas of requisite strength in sulphur dioxide (6 to 10 per cent). During two weeks 210 tons of pyrrhotite, containing 111,112 pounds of sulphur, were treated, and 191,917 pounds of sulphur dioxide recovered, thus obtaining an efficiency of 86 per cent. The average working cost, exclusive of heating and lighting, amounted to $1.86 per ton of ore treated.

Labor	$1.12	Crushing	$0.50
Power	.24	Roasting	.75
Repairs and sundries	.50	Returned and sent	.61
	1.86		1.86

Counting cost of ore, etc., the sulphur recovered cost $6 per ton of sulphur dioxide, or $12 per net ton of sulphur. When the pyrrhotite ran poorly in composition, some pyrite was used.

The conclusions reached by Mr. Sjöstedt are that pyrrhotite can be burned without special fuel, and that it can be made to yield a sufficiently strong sulphur dioxide gas for the sulphite pulp industry, and also for the manufacture of sulphuric acid.

The demand for sulphuric acid in the manufacture of fertilizers from phosphate rock is beginning to be largely supplied from pyrite, as a chemically pure sulphuric acid is not required for the purpose.

PRODUCTION.

There was a considerable increase in the production of pyrite for the manufacture of sulphuric acid in the United States during 1903, but a slight decrease in the production of natural sulphur, the combined production amounting to 233,127 long tons, valued at $1,109,818, as compared with 207,874 long tons, valued at $947,089, the production of 1902, an increase of 25,253 tons in quantity and of $162,729 in value. Besides this production, there is considerable pyrite mined for pyritic and allied smelting and for use as a flux, which would increase the output by about 75,000 to 100,000 tons. The 1903 production of pyrite was obtained from the following States, given in the order of their respective output: Virginia, Massachusetts, California, Georgia, Ohio, Alabama, Indiana, South Dakota, New Jersey. Of the total production, over one-half was obtained from Virginia. New York, which had a production in 1902, did not report any in 1903, the production being very small and being shipped principally for experimental purposes. Arkansas should become a producer of some importance during the current year.

The largest consumers of sulphuric acid in the United States are the Virginia-Carolina Chemical Company, the American Agricultural Company, and the Standard Oil Company, and it has been estimated that these three companies consume 90 per cent of the total output of domestic sulphuric acid.

The purchase of all domestic and foreign pyrite and other ores used in the United States for their sulphur content 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, and they prohibit the mining of pyrite from those deposits not most favorably located for transportation facilities.

The average price received for the 1903 production was $3.62 per ton, which is a decrease of 66 cents as compared with $4.28, the average price received for the 1902 production, and a decrease of 73 cents as compared with $4.35, the average price received per ton for the 1901 production. The value of the imported pyrite increased from $3.27 per ton in 1900 to $3.51 in 1901, to $3.75 in 1902, and to $3.89 in 1903.

The following table gives the quantity and value of the pyrite mined for its sulphur content in the United States since 1882:

Production of pyrite in the United States, 1882–1903.

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	a 241,691	1,257,879
1891	106,536	338,880	1902	a 207,874	947,089
1892	109,788	305,191	1903	a 233,137	1,109,818

a Includes production of natural sulphur.

IMPORTS AND EXPORTS.

The quantity and value of pyrite containing less than 3.5 per cent of copper imported into the United States for each year since 1884 is as follows:

Imports of pyrite containing not more than 3.5 per cent of copper, 1884–1903.[a]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1884	16,710	$50,632	1896	200,168	$648,396
1885	6,078	18,577	1897	259,546	747,419
1886	1,605	9,771	1898	252,773	717,813
1887	16,578	49,661	1899	269,868	1,077,061
1891	100,648	392,141	1900	322,484	1,055,121
1892	152,359	587,980	1901	403,706	1,415,149
1893	194,934	721,699	1902	440,363	1,650,852
1894	163,546	590,905	1903	420,410	1,636,451
1895	190,435	673,812			

[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.

This table, compared with the preceding one giving the domestic production, shows that the imports are nearly double the domestic production.

In 1902 there was a small quantity of pyrite exported, which amounted to 3,060 long tons, valued at $19,860.

CONSUMPTION.

As the imports of iron pyrite for use in the manufacture of sulphuric acid were not stated separately by the Bureau of Statistics of the Treasury Department prior to 1891, a comparison with preceding years can not be made. The following table shows the quantity of domestic pyrite mined and of foreign pyrite imported for the eleven years from 1891 to 1901, inclusive, and as no exports are reported by the Treasury Department these figures may be accepted as representing the domestic consumption. The table also shows the estimated amount of sulphur displaced each year on a basis of 45 per cent of sulphur content.

It will be observed that in the eleven years covered by the following table the amount of sulphur displaced by the use of pyrite for acid making has increased about 200 per cent. In 1891 the amount of sulphur displaced by the use of pyrite was 93,233 long tons; in 1901 the amount of sulphur displaced was 287,339 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. 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 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, 1891–1903.

Source.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
	Long tons.	*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	143,201
Imports	100,648	152,359	194,934	163,546	190,435	200,168	259,546
Domestic consumption	207,184	262,147	270,711	269,486	289,984	315,651	402,747
Sulphur displaced, estimated on basis of 45 per cent content	93,233	117,966	121,820	121,269	130,493	142,043	181,236

Source.	1898.	1899.	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Domestic product	193,364	174,734	204,615	241,691	207,874	233,127
Imports	252,773	269,868	322,484	403,706	446,363	420,410
Domestic consumption	446,137	444,602	527,099	645,397	654,237	653,537
Less exports					3,060	
					651,177	
Sulphur displaced, estimated on basis of 45 per cent content	200,762	200,071	237,195	290,430	293,031	294,063

CANADIAN PRODUCTION.

The production of pyrite in Canada in 1903 amounted to 33,530 short tons, valued at $126,133, a decrease of 2,086 tons in quantity and of $12,806 in value as compared with the production of 35,616 tons valued at $138,939 in 1902.

In the following table is shown the quantity and value of pyrite produced in Canada from 1886 to 1903, inclusive:

Annual production and value of pyrite in Canada, 1886–1903.

Calendar year.	Quantity.	Value.	Calendar year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1886	42,906	$193,077	1895	34,198	$102,594
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	1903	33,530	126,133

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 show 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, 1892–1902.

Country.	1892.	1893.	1894.	1895.	1896.	1897.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Spain *a*	435,906	393,453	511,769	480,255	98,393	217,545
France	226,304	227,288	278,452	248,934	295,325	298,571
Portugal	....	2,046	....	192,174	204,105	206,886
United States	109,788	75,777	105,940	99,549	115,483	143,201
Germany	113,391	119,379	132,621	124,994	127,092	131,160
Norway	57,629	52,890	69,720	48,217	59,534	92,966
Hungary	27,575	67,093	75,635	68,083	51,851	43,740
Italy	27,225	28,987	22,274	37,966	44,993	57,383
Canada	53,372	52,270	36,185	30,534	30,103	34,471
Newfoundland	....	37,889	40,770	34,318	27,267	32,790
Russia	13,893	20,958	19,187	12,988	12,791	19,069
United Kingdom	13,967	15,837	15,523	9,048	10,017	10,583
Bosnia	....	....	....	197	1,968	3,611
Belgium	2,529	6,200	3,001	3,454	2,519	1,798
Sweden	1,229	472	645	217	993	509
Total	1,082,808	1,100,539	1,311,722	1,390,928	1,082,434	1,294,283
Sulphur displaced *b*	487,263	495,242	590,275	625,918	487,095	582,427

Country.	1898.	1899.	1900.	1901.	1902.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Spain *a*	255,896	316,212	350,296	393,397	142,708
France	306,002	313,087	300,170	302,605	313,204
Portugal	244,229	271,228	339,892	331,641	407,173
United States	193,364	174,734	204,615	234,825	207,874
Germany	134,650	142,299	166,724	154,954	162,613
Norway	88,320	94,099	97,387	100,283	(*c*)
Hungary	57,146	78,241	85,602	92,428	104,806
Italy	66,120	75,308	70,465	87,969	91,704
Canada	28,766	24,721	35,742	31,483	31,800
Newfoundland	32,335	26,154	Nil.	7,532	26,000
Russia	24,175	22,877	22,789	(*c*)	(*c*)
United Kingdom	12,102	12,230	12,279	10,241	9,168
Bosnia and Herzegovina	236	423	1,673	4,498	5,088
Belgium	145	278	394	....	699
Sweden	380	148	176	Nil.	....
Total	1,443,866	1,552,039	1,688,204	1,651,573	1,502,837
Sulphur displaced *b*	649,739	698,418	759,692	743,208	676,277

a Exports, except in 1896.
b Based on estimated 45 per cent of sulphur content.
c Statistics not yet available.

BARYTES.

By Joseph Hyde Pratt.

INTRODUCTION.

The greatest use that is made of barytes is as a white pigment, and whereas formerly this use of barytes was considered as an adulteration of white lead it is now recognized that this mineral itself makes a good pigment. Hence, at the present time, barytes is put on the market as a pigment, and in competition with white lead and other white pigments. It has a permanent pure white color, unaffected by the weather or by gases which, in some cases, will blacken white lead. The barytes can be used to advantage also in combination with either white lead or zinc white. With any decided increase in the consumption of light-colored paints there will be a corresponding marked increase in the demand for barytes; and the very noticeable increase in the production of barytes during the last few years is due partly to that condition of the paint industry. As, however, barytes is more and more replacing the other white pigments, there is a noticeable increase in its production, due to this cause. Whatever causes may affect the paint industry, as any great increase or decrease in the construction of buildings, will bring about a corresponding change in the production of barytes. Of the total production of this mineral, about four-fifths are used in the manufacture of white pigment. The use of barytes in the manufacture of other barium compounds is also increasing.

SOURCES OF SUPPLY.

The chief source of supply of barytes is still the State of Missouri, the deposits being located in Washington, Cole, Miller, and Crawford counties, with by far the largest production from the first-named county. There were no new deposits opened in any of these counties during 1903, the production all being obtained from the same mines that furnished the supply in 1902. The Tennessee deposits, which are in Bradley, Monroe, Loudon, Cocke, and Greene counties, were worked much more extensively in 1903 than in the previous year. This increase was due largely to the production of the mines of John T. Williams & Sons; and in 1903 Tennessee was the second largest producer of barytes. North Carolina and Virginia have for several years supplied nearly the same amount of barytes per year, which has been obtained from old mines that have been worked for a number of years. The North Carolina deposits are in Madison and Gaston counties, with the larger production from the former; and those of Virginia are in Bedford, Pittsylvania, Campbell, and Tazewell counties.

In 1903 another State, Kentucky, was added to the producers of barytes, thus opening another source of supply of this mineral. Sufficient work has not been done, however, to determine definitely the quantity, and whether the mines will yield a constant supply of the mineral. The deposit is located about 2 miles from Fredonia, Caldwell County, and 11 miles from Marion, Crittenden County. The property is being developed by the Marion Zinc Company.

The Illinois deposits, near Cave in Rock, Hardin County, were further developed in 1903 by the Cleveland and Illinois Mining Company, but no production of the mineral was obtained.

A new deposit of barytes has recently been discovered near Richville, St. Lawrence County, N. Y., on the farm of Mrs. Albert Lee, on Chaumont Bay. As stated by Mr. F. H. Corbin,[a] of Dekalb Junction, N. Y., who made the discovery, the barytes vein has an average width of about 2 feet and can be traced inland for about 2,500 feet from the bay. It can also be traced out into the bay for about 240 feet. But little development work has been done on this vein beyond proving its continuity for the distance given above.

The chief source of supply of imported barytes is Germany. Small amounts of this mineral are produced in the Provinces of Nova Scotia and Quebec, Canada, the Nova Scotia deposits being operated by Henderson & Potts, of Halifax, and the Eastern Milling Company, of Dartmouth, and those in Quebec Province being operated by the Canada Paint Company, of Montreal. The total production of the Canadian mines was 1,163 short tons, valued at $3,931.

Barytes is also being mined at Colliers Bay (Trinity Bay), Newfoundland, by the Colliers Bay Barite Company, and the production is increasing. In 1903 it amounted to 4,300 short tons, valued at $8,600. A portion of the product was exported to the United States.

PRODUCTION.

The production of crude barytes in the United States in 1903 amounted to 50,397 short tons in quantity, valued at $152,150 at the mine. This is a decrease of 11,271 tons in quantity and of $51,004 in value, as compared with the production of 1902, which was 61,668 short tons, valued at $203,154. The average value per ton of the 1903 production was $3.02, which is 27 cents less than the average value

[a] Personal letter.

per ton ($3.29) of the production of 1902. In 1901 the production of barytes was 49,070 tons, valued at $157,844, which is an average price of $3.22 per ton. Although the quantity of the production of 1903 was greater than that of 1901, the value was less, the average price per ton being 20 cents less.

The production of 1903 was obtained from Missouri, Tennessee, North Carolina, Virginia, and Kentucky, which are given in the order of their production, Missouri being the largest and Kentucky the smallest producer.

In the following table are given the quantity and value of the production of barytes in the United States in 1902 and 1903, by States:

Production of crude barytes in 1902 and 1903, by States.

State.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Missouri	31,384	$104,677	23,178	$77,712
North Carolina	14,679	44,130	6,835	21,347
Tennessee	3,255	14,647	[a] 14,684	32,691
Virginia	12,400	39,700	5,700	20,400
Total	61,668	203,154	50,397	152,150

[a] Includes the small production of Kentucky.

As is seen from this table, there was a very large increase in the production of Tennessee in 1903 over 1902, somewhat more than four times as much, while that of Missouri, North Carolina, and Virginia was considerably less.

The annual production of crude barytes in the United States since 1882 is given in the following table:

Production of crude barytes, 1882–1903.

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	61,668	203,154	3.29
1892	32,108	130,025	4.05	1903	50,397	152,150	3.02

[a] Value at St. Louis, and includes some floated barytes.
[b] Value includes floated barytes when sold first in that form.

The year of greatest production was 1900, when it amounted to 67,680 tons, valued at $188,089, or an average price of $2.78 per ton; but the year of greatest value was 1902, when the production of 61,668 tons was valued at $203,154, or an average value of $3.29 per ton. The variation in the value of the production is due principally to the greater or less quantity of No. 1 barytes that is mined.

After the crude barytes is cleaned and ground, its value is increased from $2 to $4 per ton to $7 to $14 per ton, these latter figures representing the value of the manufactured barytes ready for use as a pigment and for the manufacture of other barium compounds.

IMPORTS.

There is still considerable crude barytes imported into the United States, principally from Germany, with a small amount from Newfoundland, which during the past few years has been steadily increasing. In 1903 the imports amounted to 5,716 short tons, valued at $48,726, of manufactured barytes, an average value of $8.54 per ton, and to 7,105 short tons of crude barytes, valued at $22,777, an average value of $3.21 per ton.

There is given in the following table the quantity and value of the manufactured and crude barytes imported into the United States since 1867:

Imports of barytes, 1867–1903.

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	8,562
1887	4,057,831	19,769	10,190,848	13,290
1888	3,821,842	17,135	6,504,975	9,037

Imports of barytes, 1867–1903—Continued.

Year ending—	Manufactured.		Unmanufactured.	
	Quantity.	Value.	Quantity.	Value.
December 31—Continued.	*Pounds.*		*Pounds.*	
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	1,844	5,270
1895	1,629	17,112	2,551	7,561
1896	2,467	23,345	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	14,822
1903	5,716	48,726	7,105	22,777

[a] Short tons since 1890.

These figures do not represent all of the barium compounds imported into the United States, for besides the above manufactured and unmanufactured barytes, there were imported in 1903 other barium compounds to the value of $224,539. The table below gives the kind and value of the imports of these various barium compounds in 1902 and 1903.

Value of the imports of other barium compounds in 1902 and 1903.

Barium compound.	1902.	1903.
Witherite, barium carbonate	$12,777	$35,762
Barium binoxide	66,746	84,549
Barium chloride	46,905	68,762
Blanc fixe, or artificial barium sulphate	25,933	35,466
Total	152,361	224,539

The value of these barium compounds is very much greater than that of the natural barytes, this being especially true of the barium binoxide. The artificial sulphate is valued at $25.72 per ton, as compared with $9 per ton for the natural barium sulphate or barytes. All of these barium compounds, with the exception of the witherite (the natural barium carbonate), could and should be manufactured in this country from American barytes, and there should be a profitable field for the manufacturing chemist in the production of these barium compounds.

STRONTIUM.

There was no production of strontium minerals in the United States during 1903, although celestite, the strontium sulphate, is known to occur in some quantity at a number of localities, principally near Put in Bay, on Strontian Island, Ottawa County, Ohio; near Burnet, Burnet County, Tex.; at Drummond, Drummond Island, Chippewa County, Mich.; at Cedar Cliff, Mineral County, W. Va.; and in the vicinity of Schoharie, Schoharie County, N. Y. The deposit near Put in Bay, Ohio, will probably be worked in 1904 by Mr. F. J. Herbster, of that place, although the property is still in litigation. There is little or no market at the present time for these minerals in this country, and any production that would be obtained would be exported. There is no large demand for these minerals on account of their limited uses; and now barium hydroxide is taking the place of strontium in one of its principal uses—that is, in refining beet sugar. The other main use of the strontium minerals is in the preparation of the carbonate and the oxalate of strontium, which are used in pyrotechnics for red fire. Very small quantities of iodide, bromide, and lactate of strontium are used in medicine. Another use that has been suggested for strontium, which, however, would require but a small quantity, is in the preparation of the sulphide for use in the manufacture of phosphorescent compounds, for luminous paints, etc.[a]

Of the strontium salts used in the United States nearly all are imported from Germany, and in 1903 the value of these imports was $1,337.

[a] Journal of the Franklin Institute, April, 1902.

MINERAL PAINTS.

By Joseph Hyde Pratt.

MINERALS USED AS PIGMENTS.

There are a number of mineral substances that are mined and prepared primarily for use as pigment. These are the iron ores, hematite and limonite, which are ground and used in the manufacture of metallic paint and which are not included under the production of iron ores; ocher, clay, and other earths containing iron which are used for yellow and brown pigments, such as ocher, umber, sienna, etc.; barytes (or heavy spar) used for white pigment; slate or shale; and graphite. Other minerals that are directly used in the manufacture of paints are asbestos and soapstone, which have been utilized principally in the manufacture of fireproof paints and paste.

Besides these minerals that are used in the natural state there are a number of other substances included under the head of mineral paints that are manufactured products, such as the various lead pigments, white lead, red lead, litharge, and orange mineral.

PRODUCTION.

The total production in 1903 of the natural mineral paints included in this report, consisting of metallic paint (including mortar colors), ocher, umber, sienna, Venetian red, zinc white, slate, graphite, and carbonaceous shales and schists, amounted to 126,649 short tons, valued at $5,437,275. As compared with the production of 125,694 short tons, valued at $4,960,831 in 1902, this is an increase of 955 short tons in quantity and of $476,444 in value. This increase in value is due to the increase in the production of the higher priced pigments.

In the following table is given the production of the various mineral paints for the years 1896 to 1903, inclusive:

Production of mineral paints, 1896–1903.

Kind.	1896.		1897.		1898.		1899.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Ocher	14,074	$136,458	14,006	$162,764	11,963	$123,832	14,124	$140,166
Umber	165	2,646	*a* 1,080	11,710	*b* 1,177	8,285	473	4,151
Sienna	395	5,416	620	10,610	689	11,140	588	8,205
Metallic paint	14,805	180,134	16,699	187,694	20,972	263,979	23,423	249,945
Mortar color	9,660	89,600	8,287	75,570	7,107	74,894	5,736	65,156
Venetian red	4,138	98,856	13,603	294,744	10,271	160,711	11,991	210,361
Zinc white	20,000	1,400,000	25,000	1,750,000	33,000	2,310,000	40,146	3,211,680
Soapstone	....	....	2	20	100	800	100	700
Slate *c*	4,795	44,835	4,666	46,681	4,571	46,215	4,676	43,708
Other colors	....	....	2,000	6,000	2,000	6,000	2,000	6,000
Total	68,032	1,952,955	85,913	2,545,793	91,850	3,005,856	103,257	3,940,069

Kind.	1900.		1901.		1902. *d*		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Ocher	17,015	$186,707	16,711	$177,779	16,565	$145,708	12,524	$111,625
Umber	1,452	26,927	759	11,326	480	11,230	666	15,367
Sienna	957	14,771	305	9,304	189	4,316		
Metallic paint	23,218	261,831	15,915	204,937	*e* 19,020	313,390	25,108	213,109
Mortar color	6,689	79,911	9,346	112,943	8,855	98,729	10,863	101,792
Venetian red	14,696	236,574	9,201	153,467	11,758	196,905	7,425	134,635
Zinc white	48,840	3,667,210	46,500	3,720,000	52,645	4,016,499	62,962	4,801,718
Soapstone	100	700	50	350	1,100	2,200	....	....
Slate *c*	6,395	53,942	4,865	41,211	*f* 4,071	39,401	7,106	59,029
Other colors	1,700	20,000	4,308	78,625	*g* 11,511	132,453	....	....
Total	121,062	4,548,573	107,960	4,509,962	125,694	4,960,831	126,649	5,437,275

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.

As is seen from this table there was a decided decrease in the production of ocher in 1903, which amounted to 4,041 short tons. There was also a slight falling off in the production of sienna, but a small increase in the production of umber.

This table shows also that there is a wide variation between the production and the value per ton of the various mineral paints from year to year. This is due to the comparatively wide range in the quality of the materials that are mined during these years, and to the fact that a larger production of a higher or lower priced article will bring about a comparatively larger or smaller increase in the value, so that the rise or fall shown in the average price may be apparent only. Where, however, the quality of the pigment is practically uniform, as in zinc white and venetian red, this variation is not so noticeable. When the average value per ton of all mineral pigments used is considered, it must be borne in mind that according to trade conditions there may be a displacement in the market of some higher-priced paint by a cheaper article; thus barytes, which is used as a white pigment, is very much cheaper than zinc white or white lead, and is being used largely in combination with one or both of these other white pigments.

OCHER, UMBER, AND SIENNA.

PRODUCTION.

During 1903 the production of ocher in the United States amounted to 12,524 short tons, valued at $111,625. As compared with the production in 1902 of 16,565 short tons, valued at $145,708, this is a decrease of 4,041 short tons in quantity and of $34,083 in value. The seven States contributing to this output of ocher, given in the order of the importance of their production, were Georgia, Pennsylvania, Arkansas, Iowa, California, Vermont, and Virginia. Missouri and Illinois, which were numbered among the producers of ocher in 1902, reported no production during 1903. In Iowa, Arkansas, and Virginia there was only one producer which reported any output. For this reason it has been necessary to consolidate the production of these States in order to preserve confidentially the information concerning the output of the individual companies.

Of the 1903 production, Georgia produced 41.6 per cent of the total output, while Pennsylvania, which had the largest output, 59 per cent, in 1902, produced only 39 per cent of the 1903 output. The production from Georgia amounted to 5,212 short tons, valued at $47,908, in 1903, as against 3,686 short tons, valued at $38,425, in 1902. The production from Pennsylvania was 4,937 short tons, valued at $34,782, in 1903, as against 9,818 short tons, valued at $80,259, in 1902.

Pennsylvania was the only State reporting any production of umber or sienna during 1903. The combined production of these two mineral paints was 666 short tons, valued at $15,367, as compared with 669 short tons, valued at $15,546, in 1902, a decrease of 3 tons in quantity and of $179 in value. In 1902 there were three other States, Illinois, Georgia, and New York, which reported a production of these mineral paints.

In the following tables are shown the production of ocher by States for the last four years and the total production of ocher, umber, and sienna since 1896. The variations in the value of these mineral paints are due chiefly to the increase or decrease in the production of the different grades of the materials rather than to fluctuations in prices.

Production of ocher in 1899, 1900, 1901, 1902, and 1903, by States.

State.	1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Georgia	6,828	$73,172	5,077	$49,176	3,688	$38,428	5,212	$47,906
Pennsylvania	7,601	84,661	7,632	76,106	9,818	80,259	4,937	34,782
Vermont	401	3,856	370	3,493	441	4,544	(a)	(a)
California					580	3,650	(a)	(a)
Other States	2,185	25,018	3,632	49,024	2,038	18,832	b2,875	b28,985
Total	17,015	186,707	16,711	177,799	16,565	145,708	12,524	111,625

a Included in Other States. b Including California, Iowa, Vermont, and Virginia.

Production of ocher, umber, and sienna, 1896–1903.

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	a1,080	11,710	620	10,610	15,706	185,084
1898	11,963	123,832	b1,177	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
1903	12,524	111,625	c666	15,367			13,190	126,992

a Includes 600 tons Spanish brown from Maryland.
b Includes 640 tons Spanish brown from Maryland.
c Includes the production of sienna.

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	17,556	$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	141,823
1888	10,000	120,000	1894	10,193	104,015
1889	15,158	177,472	1895	12,640	150,636

IMPORTS.

The following tables show the quantity and value of ochers of all kinds imported into the United States from 1867 to 1903, 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	3,985,978	32,598
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	3,212,968	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	137,978	6,143	1,549,968	13,788	6,972	885	7,022,615	90,598

Imports of ocher of all kinds, 1884–1903.

Year ending—	Dry.		Ground in oil.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
June 30—	*Pounds.*		*Pounds.*		*Pounds.*	
1884	a 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	b 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
1903	9,839,999	99,269	20,335	1,178	9,960,334	100,447

a Since 1883 classified as "dry" and "ground in oil."
b Since 1896 classified as "dry—crude and powdered, washed or pulverized."

Imports of umber, 1867–1903.

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	16,596
1869	570,771	6,159	1888	1,423,800	14,684
1870	708,825	6,318	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	9,061
1880	1,877,645	17,271	1899	*e* 1,739,036	13,336
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	1903	*i* 2,168,570	13,172
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."
i Includes 9,656 pounds "ground in oil" and 2,158,914 pounds "dry—crude and powdered, washed or pulverized."

Imports of sienna, 1893–1903.

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	1,626,586	$138,889	5,857	$610	1899	798,691	$14,470	6,484	$492
1894	337,909	9,424	18,877	895	1900	796,584	14,912	6,335	495
1895	456,861	11,021	6,576	501	1901	1,106,553	18,294	13,861	1,004
1896	668,461	10,857	10,848	877	1902	1,534,878	27,299	5,921	494
1897	580,468	12,340	7,058	481	1903	1,873,532	28,447	1,387	123
1898	544,713	11,451	4,008	280					

PRODUCTION OF OCHER IN PRINCIPAL PRODUCING COUNTRIES.

In the following table the output of ocher in the principal producing countries of the world for the years 1893 to 1903, inclusive, is given as far as the statistics are available. The United States ranks third in the quantity of the production in 1902; France is first, and Great

Britain second. The French production has amounted each year to more than the combined production of the United States and Great Britain.

Production of ocher in principal producing countries, 1893–1903.

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	66,062	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	69,585	39,357	275,930	77,047	102,385
1902	16,565	145,708	18,999	112,030	38,326	361,687	15,374	27,863
1903	12,524	111,625	....	....	....	....	....	....

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	3,298
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	2,315	8,400	181	528	[a]2,643	6,505
1902	4,955	30,495	220	800	....	....	[a]2,093	4,840
1903	6,226	32,440	....	....	....	....	....	....

[a] Umber exports.

METALLIC PAINT.

The minerals that are used in the manufacture of metallic paint are hematite and limonite, two of the iron ores. When limonite is used it is necessary to roast the ores before grinding, in order to drive off the water of crystallization in the mineral. This also changes the color of the mineral from yellow to a deep red or a reddish brown. It is also necessary in some cases to roast the hematite ores in order to improve the color and durability. Although these two minerals occur in a great many places in the United States, and in enormous deposits, the quantity of these ores that are suitable for making a good metallic paint is very small, and there are but few localities that can furnish it. The principal localities which contain ores that will make a good metallic paint are Oneida, Rensselaer, Cattaraugus, and Washington counties, N. Y.; Lehigh, Carbon, and Mercer counties, Pa.; Washington and James counties, Tenn., and Dodge County, Wis. It has also been produced in small quantities in Maryland, Arkansas, California, Illinois, Iowa, Vermont, Missouri, Ohio, Virginia, and Wyoming. Some of the ore ground for paint is used as a coloring material in mortar making. An attempt has been made to separate that portion of metallic paint that has been used for mortar colors, but it has been impossible to determine exactly just how much of these paints was used for this purpose. The figures given in the table of production are approximately correct.

PRODUCTION.

The production of metallic paints in 1903 was obtained from Pennsylvania, New York, Ohio, Tennessee, Wisconsin, Alabama, Maryland, New Jersey, and Virginia, named in the order of the importance of their production. The output amounted to 35,966 short tons, valued at $314,901; the production in 1902 was 27,375 short tons, valued at $412,119. Of the production of 1903, 25,103 tons, valued at $213,109, was of metallic paint exclusive of mortar colors, as compared with 19,020 short tons, valued at $313,390 in 1902, an increase of 6,083 tons in quantity, but a decrease of $100,281 in value. The production of mortar colors in 1903 was 10,863 short tons, valued at $101,792, as compared with 8,355 short tons, valued at $98,729, in 1902, an increase of 2,508 short tons in quantity and of $3,063 in value.

In the following table are given the statistics of production of metallic paint and mortar colors during 1901, 1902, and 1903, by States:

Production of metallic paint and mortar colors in 1901, 1902, and 1903, by States.

State.	1901.				1902.				1903.			
	Metallic paint.		Mortar colors.		Metallic paint.		Mortar colors.		Metallic paint.		Mortar colors.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*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	4,660	$42,180	6,362	$53,619
Pennsylvania	8,422	120,298	2,150	22,400	9,981	233,832	925	10,600	11,120	112,810	1,800	22,200
Tennessee	3,100	27,350	1,500	15,000	5,150	40,880	969	12,990	......	......	......	......
Ohio	......	......	......	......	......	......	......	......	771	12,020	......	......
Other States	2,328	31,989	2,396	30,543	a2,489	23,678	1,927	25,739	8,552	46,099	2,701	25,973
Total	15,915	204,737	9,346	112,943	19,020	313,390	8,355	98,729	25,103	213,109	10,863	101,792

a Includes 800 tons of unground material, valued at $800.

The annual production of metallic paint and mortar colors from 1889 to 1903, inclusive, has been as follows:

Production of metallic paint and mortar colors, 1889–1903.

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	....	....	1897.....	16,699	$187,694	8,237	$75,570
1890......	24,177	340,369	....	....	1898.....	20,972	263,979	7,107	74,894
1891......	25,142	334,455	....	....	1899.....	23,423	249,945	5,736	65,156
1892......	25,711	362,966	....	....	1900.....	23,218	261,831	6,689	79,911
1893......	19,960	297,289	....	....	1901.....	15,915	204,737	9,346	112,943
1894......	15,225	189,922	10,150	$94,961	1902.....	18,220	312,540	8,355	98,729
1895......	17,315	212,761	11,544	106,381	1903.....	25,103	213,109	10,868	101,792
1896......	14,805	180,134	9,660	89,600					

[a] Includes mortar colors from 1889 to 1893, inclusive.

VENETIAN RED.

Venetian red is not a true mineral paint, inasmuch as it is made from iron sulphate (commonly called "copperas" or "green vitriol"), which is itself a manufactured product and not a natural mineral substance. The iron sulphate is subjected to a roasting process, during which the sulphur is oxidized and driven off as sulphur dioxide. This leaves the iron oxide as a very bright red substance, which has a more brilliant color than the natural iron oxide pigment, which is included under metallic paint.

PRODUCTION.

During 1903 the production of Venetian red was 7,425 short tons, valued at $134,635, as compared with 11,758 short tons, valued at $196,905, in 1902, a decrease of 4,333 tons in quantity and of $62,270 in value. The following table shows the annual production of Venetian red since 1890:

Production of Venetian red, 1890–1903.

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	210,861
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	1903........................	7,425	134,635

SLATE GROUND FOR PIGMENT.

PRODUCTION.

Mineral black is the name applied to the product of the dark colored slates and shales that are ground for paint, and in 1903 the total quantity of these materials that were used for this purpose amounted to 7,106 short tons, valued at $59,029, an increase of 3,035 tons in quantity and of $19,628 in value as compared with the production of 4,071 short tons, valued at $39,401, in 1902.

The following table does not include the production of the graphitic or carbonaceous shale or schist of Michigan, which is known as "Baraga graphite," nor the graphitic material obtained from Rhode Island. Both are used to some extent in the manufacture of graphite paints, as are also the purer forms of graphite from New York and Pennsylvania, the statistics of the production and value of which are included in those of graphite.

The annual production of pigments made from slate and shale since 1880 have been as follows:

Quantity and value of slate and shale ground for pigment, 1880–1903.

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	35,870
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	43,708
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	1903	7,106	59,029

[a] Includes mineral and carbon black.

LEAD PAINTS.

WHITE LEAD, SUBLIMED LEAD, ZINC LEAD, RED LEAD, LITHARGE, AND ORANGE MINERAL.

Although the lead pigments do not represent mineral paints in the sense of those just described, they are included under this head as they are the products of metallic lead, from which they are manufactured, but their value is excluded from the tabulation in order to avoid duplication. The lead pigments included here are white lead, sublimed lead, zinc lead, red lead, litharge, and orange mineral.

PRODUCTION.

During 1903 the aggregate production of all lead pigments amounted to 141,486 short tons, valued at $15,711,595, an increase of 18,095 short tons in quantity, and of $3,058,810 in value as compared with the production of 123,391 short tons, valued at $12,652,785, in 1902. The imports of these lead pigments in 1903 amounted to 1,203 short tons, valued at $103,312, as against 1,334 short tons, valued at $114,-671, in 1902. This makes the total amount of lead pigments consumed in the United States in 1903 equal to 142,689 short tons, valued at $15,814,907, as against 124,725 short tons, valued at $12,767,456, in 1902.

WHITE LEAD.

PRODUCTION.

The total production of white lead in 1903 amounted to 112,886 short tons, valued at $12,837,647, a decrease of 772 short tons in quantity, but an increase of $859,473 in value as compared with the production of 114,658 short tons, valued at $11,978,174, in 1902. Of the 1903 production, the quantity of white lead in oil was 62,674 short tons, valued at $7,482,487, and the quantity of dry white lead and white oxide was 50,212 short tons, valued at $5,355,160.

The import of white lead during 1903 amounted to only 227 short tons, valued at $24,495, which indicates the gradual displacing of the imported pigments by those of domestic production.

There is a tendency to substitute zinc white and barytes for white-lead pigments on account of the poisonous effects on the employees of the fumes given off in the manufacture of the white lead. A series of experiments have recently been conducted by M. N. J. Breton,[a] a French scientist, as to the relative merits of different white paints, and the results of his works are summed up as follows:

> White lead resists the action of certain acids better than its substitutes, but on the other hand it is quite inferior under the action of heat or sudden change of temperature, also of hydrosulphurous emanations and of certain strong oxidizing agents, such as hypochlorite of soda. Besides, the white-lead paints are much less adhesive to the surfaces to which they are applied and have a marked tendency to blow up. The addition of sulphate of barium to white lead, while diminishing its covering power considerably, does not seem to render the paint any less resistant. The addition of a siccative to zinc oxide in the proportion needed to give these paints a drying quality equal to that of the white-lead paint does not diminish the resistance of the paint, and often, on the contrary, at least in certain cases, increases its solidity. The white lead forms a simple mixture with linseed oil and not a combination, and the mixture is less homogeneous than that which is formed by oxide of zinc.

In experimenting as to the covering power of white lead and zinc oxide M. Breton found that for equal weights the spreading capacity of zinc oxide is nearly double that of white lead; for equal volumes

[a] Scientific American, Dec. 19, 1903.

the covering power of zinc oxide is superior to that of white lead; but as zinc oxide forms a more fluid mixture with the oil, it is necessary in practice to make the zinc paint thicker in order to obtain the same result as with the white lead.

The annual production of white lead since 1884 has been as follows:

Production of white lead in the United States, 1884-1903.

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	8,371,586
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	74,485	8,733,620	1902	114,658	11,978,174
1893	72,172	7,695,130	1903	112,886	12,837,647

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, 1874-1903.

[Per 100 pounds.]

Year.	Pig lead.	White lead in oil.	Difference.	Year.	Pig lead.	White lead in oil.	Difference.
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	2.06
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	.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	4.21½	5.62	1.40½
1888	4.41	5.75	1.34	1903	4.23	6.39	2.16

SUBLIMED LEAD.

Another lead pigment which is sometimes classed as a white lead is known as sublimed lead and is obtained as a by-product in the oxidizing smelting of galena ores; it consists essentially of lead sulphates and lead oxide. The output of this pigment in 1903 produced by the Picher Lead Company, of Joplin, Mo., amounted to 8,592,000 pounds, valued at $386,640, as against 9,465,500 pounds, valued at $449,611, in 1902.

ZINC LEAD.

There is manufactured at Canyon, Cal., by the United States Production and Refining Company, a product known as zinc lead, which is a pigment consisting of the mixture of an oxide compound of zinc and lead obtained by an oxidizing, smelting treatment of lead in zinc ores in a furnace of special design. The production of this pigment in 1903 amounted to 4,500 short tons, valued at $247,500, as against 4,000 short tons, valued at $225,000, in 1902, and 2,500 short tons, valued at $150,000, in 1901.

RED LEAD, LITHARGE, AND ORANGE MINERAL.

The production of red lead during 1903 shows a considerable decrease from that of 1902, being 8,832 short tons, valued at $1,022,754, as compared with 11,669 short tons, valued at $1,263,112, in 1902. This is a decrease of 2,837 short tons in quantity and of $240,358 in value.

The combined production of litharge and orange mineral during 1903 was 10,972 short tons, valued at $1,217,054, as compared with 13,742 short tons, valued at $1,437,692, in 1902, a decrease of 2,770 tons in quantity and of $220,638 in value.

There is still a considerable quantity of red lead and orange mineral imported into the United States, and in 1903 this amounted to 1,152,715 pounds of red lead and 756,742 pounds of orange mineral. Of the litharge 42,756 pounds were imported during 1903. In the following table is given the production of white lead, sublimed lead, zinc lead, red lead, litharge, and orange mineral for the years 1901, 1902, and 1903:

Production of white lead, sublimed lead, zinc lead, red lead, litharge and orange mineral during 1901, 1902, and 1903.

	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
White lead:	*Pounds.*		*Pounds.*		*Pounds.*	
In oil	154,606,670	$8,978,441	179,478,588	$9,755,197	125,348,000	$7,482,487
Dry[a]	46,966,945	2,274,212	49,841,821	2,222,977	102,424,000	5,355,160
Sublimed lead			9,465,500	449,611	8,592,000	386,640
Zinc lead	5,000,000	150,000	8,000,000	225,000	9,000,000	247,500
Red lead	26,206,096	1,448,550	23,338,252	1,263,112	17,664,000	1,022,754
Litharge	18,919,086	979,586	25,510,690	1,298,343	20,642,000	1,116,361
Orange mineral	2,174,727	224,667	1,978,521	139,349	1,302,000	100,693

[a] Including white oxide.

IMPORTS.

The quantity and value of the imports of white lead, red lead, litharge, and orange mineral from 1867 to 1903, inclusive, are given in the following table:

White lead, red lead, litharge, and orange mineral imported, 1867–1903.

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	1,518,794	85,644	66,544	3,396	...	...
1873	6,331,373	408,986	1,588,089	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	143,287	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	3,106	...	...
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
1894	796,480	40,939	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
1903	453,284	24,595	1,152,715	40,846	42,756	1,464	756,742	36,407

ZINC WHITE.

As was stated under the head of white lead, there has been considerable work done in experimenting as to the actual value of zinc white as a pigment in competition with white lead, and the experiments have resulted in showing that zinc white can be used satisfactorily in competition with white lead. As has already been stated, zinc white has also the advantage of the fact that in its manufacture the workmen are not subject to any poisonous fumes as they are in the manufacture of white lead. The production of zinc white has increased steadily for the last ten years, and during 1903 it amounted to 62,962 short tons, valued at $4,801,718, as compared with 52,730 short tons, valued at $4,023,299, in 1902, an increase of 10,232 short tons in quantity and of $778,419 in value.

The following table gives the production of zinc white (zinc oxide) from 1880 to 1903, inclusive, and illustrates the continual growth in the manufacture of this pigment:

Production of zinc white, 1880–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	10,107	$763,788	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	1903	62,962	4,801,718

IMPORTS.

There continues to be a considerable import of zinc oxide into the United States each year, but it represents but a small percentage of the total quantity of this pigment consumed. During 1903 the imports of zinc oxide were: Dry, 3,487,042 pounds; in oil, 166,034 pounds; total, 3,653,076 pounds, as compared with dry, 3,271,385 pounds; in oil, 163,081 pounds; total, 3,434,466 pounds in 1902, an increase for 1903 of 218,610 pounds, or about 6 per cent over the imports of 1902.

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), 1885–1903.

Year ending—	Dry.	In oil.	Year ending—	Dry.	In oil.	Total value.
	Pounds.	Pounds.	Dec. 31—	Pounds.	Pounds.	
June 30, 1885	2,233,128	98,566	1894	3,371,292	59,291	$122,690
Dec. 31—			1895	4,546,049	129,343	153,641
1886	3,536,289	79,788	1896	4,572,781	311,023	161,188
1887	4,961,080	123,216	1897	5,564,763	502,357	206,636
1888	1,401,342	51,985	1898	3,342,235	27,050	130,039
1889	2,686,861	66,240	1899	3,012,709	41,699	172,359
1890	2,631,458	102,298	1900	2,618,808	38,706	142,395
1891	2,839,351	128,140	1901	3,199,778	128,198	166,908
1892	2,442,014	111,190	1902	3,271,385	163,081	167,084
1893	3,900,749	254,807	1903	3,487,042	166,034	188,494

In addition to the imports given in the preceding table there were imported during 1903, 1,129,805 pounds of white sulphide of zinc, valued at $33,077. Zinc sulphide is known commercially as lithopone.

ASBESTOS.

By Joseph Hyde Pratt.

INTRODUCTION.

In previous reports on the subject of asbestos detailed descriptions have been given of the two minerals which form the sources of commercial asbestos, the chrysotile and the amphibole varieties, and they have been compared as to their relative market values and the demand for them. The American localities for both these varieties of asbestos have also been described somewhat at length. In the present report, therefore, these points are only touched upon, while the uses of asbestos and the origin of the chrysotile variety are taken up more in detail.

The demand for the chrysotile asbestos is still increasing, while that for the amphibole is only just holding its own. It is because of the cheapness with which the amphibole asbestos can be mined and manufactured and because of the scarcity of the chrysotile variety that even the small demand for the inferior amphibole asbestos is maintained.

OCCURRENCE AND LOCALITIES.

The amphibole asbestos, which is usually found in granitic or schistose rocks, either in pockets or in well-defined veins, occurs in such quantity and forms such a very high percentage of the rock mass that is removed in mining or quarrying it, that its cost per ton for mining is very low. On the other hand, the chrysotile variety, which is always found in serpentine rocks, does not occur in any regular vein formation, but as seams of varying width which pinch out and widen, sometimes clustering together and again occurring sparingly, so that it is necessary to mine from 30 to 90 tons of the rock to obtain one ton of the asbestos. The heat-resisting properties of both of these varieties of asbestos is approximately the same, so that when this characteristic of the asbestos is the only quality desired the amphibole variety would give as good satisfaction as the chrysotile, but whenever strength of fiber as well as nonconductivity of heat is desired, the chrysotile variety is the only one that can be used satisfactorily.

The sources of supply of amphibole asbestos in the United States are very numerous, and during the last two years a number of new companies hav^ been organized and have begun operations for the production of this variety of asbestos, but on account of the small demand for it their production and sale must be limited.

The Connecticut Asbestos Mining Company, whose deposits of amphibole asbestos are in the town of New Hartford, Conn., has erected a complete plant for crushing and rolling the crude rock and for separating the fiber. This company treated a small portion of its production of 1903 and prepared it for market. At the Bedford County, Va., deposits of the American Asbestos Company a 40-ton plant for crushing and separating the asbestos is nearly completed. This company has mined a large quantity of crude rock and has it stored ready for treatment when its mill shall be completed.

The Sall Mountain Asbestos Company, whose deposits are located at Sall Mountain, White County, Ga., still continues to be the largest producer of asbestos in the United States. There was no production in 1903 from the other Georgia deposits of amphibole asbestos. This is also true of the North Carolina deposits located in Polk, Mitchell, and Wilkes counties, where this variety of asbestos is known to occur in large quantity; and it is true also of the Wisconsin deposits located near Stevens Point, Wood County, and of the Vermont deposits.

Notwithstanding its quantity, cheapness, and ease of production and transportation, many of the largest manufacturers of asbestos products in the United States do not handle the amphibole variety.

There was a small production of the chrysotile asbestos in 1903 from the Dalton locality, in Massachusetts. There are a number of localities from which specimens of chrysotile asbestos have been received and examined, some of which were of very fine quality. There was no production of any chrysotile asbestos during 1903 at the Vermont localities in Orleans and Lamoille counties. The most promising deposits in this section are those of the Vermont Asbestos Company and the Tucker Asbestos Company. The former company's deposits are located about 6 miles northeast of Belvidere Mountain and 2 miles northeast from the village of Lowell. The Tucker Asbestos Company's property is on the eastern slopes of Belvidere Mountain, in the southwestern part of Lowell Township, Orleans County, about 5 miles southwest of the village of Lowell. Development work was carred on in 1903 on both these properties, and they offer perhaps at the present time the most favorable opportunity in the Vermont district for developing deposits of chrysotile asbestos.

There was no production in 1903 from the Wyoming, California, North Carolina, and Michigan deposits, which were described in the report for 1902.

The deposits of chrysotile asbestos in the Grand Canyon, Arizona, which are owned by the Hance Asbestos Company, were mined to a small extent, but most of the work was along the line of development. Hence the production of asbestos from this property in 1903 was small. The quality of the asbestos is exceptionally good, and some of the fibers are 3 inches in length. Although this property is in the Grand Canyon of the Colorado and on the north side of the river, about 3,500 to 4,000 feet below the rim, it is well worthy of thorough investigation on account of the quantity and the quality of the asbestos now exposed.

In 1903 a deposit of chrysotile asbestos was found in Arizona at the head of Pinto Creek, 23 miles west of Globe, Gila County. This deposit has been located by Mr. M. L. Shackelford, of Prescott, Ariz. The serpentine in which the asbestos occurs can be traced for over 3 miles, and the asbestos occurs near the contact of the serpentine with the other country rock, and is found in small seams over a width of from 5 to 40 feet. Samples of this asbestos have been examined and were found to be of the finest quality, the fibers varying from a fraction of an inch to 2 or 3 inches in length. The only work that has been done on this deposit up to the present time is the one year's assessment work, so that there is not very much known as yet regarding the extent of the deposit or the percentage of asbestos that can be obtained in mining.

In Yancey County, N. C., about 8 miles west of Spruce Pine, on the road to Burnsville, near the junction of the North and the South Toe rivers, chrysotile asbestos has been found in some quantity on a hill which rises about 300 feet above the surrounding country. The fiber is of good quality, and although but little work has been done on the deposit, the serpentine has been proved to contain the asbestos for a distance of 250 feet in length by 50 to 75 feet in width. A tunnel running about 35 feet below the outcrop encountered the same chrysotile asbestos at that depth. The deposit is within 2 miles of the railroad and is thus insured favorable transportation facilities. This property is being developed by Mr. O. H. Blocker, of Old Fort, N. C.

Canada continues to be the chief source of supply of the chrysotile asbestos, and a large proportion of its production is imported into the United States. During 1903 several foreign localities for chrysotile asbestos were reported, but thus far none of them have been developed to such an extent that their products are on the market in any considerable amount. One deposit, which is being investigated by Mr. H. G. Neelands, of Nelson, British Columbia, is located in the Lardeau Valley, in Saskatchewan, on that branch of the Canadian Pacific which leads to Trout Lake.

An asbestos deposit in the province of Kuopio, Finland, about halfway between Kuopio and Joensuu and close to the railroad, has recently been located, and it is stated that large quantities of the mineral have been exposed ready for quarrying.

Another deposit of asbestos is reported to have been discovered in the province of Irkutsk, in Siberia, about 1½ miles from the Kitoi River. This river affords ample water power and cheap transportation to the railroad. There have been a number of companies organized to develop these various deposits. According to the consular reports, the fiber is of very good quality and equal to the Canadian.

Considering the value of chrysotile asbestos and the increasing demand for it, which would become much greater if there was much reduction in the price, it is only natural that any new deposit of this mineral, irrespective of its location, should attract a great deal of attention.

PRODUCTION.

During 1903 the production of asbestos in the United States was principally from the Sall Mountain, White County, Ga., deposits, with smaller quantities from near Dalton, Berkshire County, Mass., New Hartford, Conn., and Grand Canyon, Arizona. The total quantity amounted to 887 short tons, valued at $16,760, with an average value of about $19 per ton. This production is a decrease of 118 tons in quantity and an increase of $560 in value as compared with that of 1902, which amounted to 1,005 tons, valued at $16,200. This relatively large increase in value is due to the high price per ton received for the product from the Grand Canyon in Arizona, which averaged about $150 per ton. Besides the above production, there were reported about 4,000 tons of crude asbestos rock obtained in development work, which have not been treated in any way and are for the most part still on the mine dumps. The production was all of the amphibole variety, with the exception of the small amount of asbestos produced in Massachusetts and in Arizona, which was of the chrysotile variety. The decrease in the amount of asbestos produced in the United States is due to the very small demand for the amphibole variety, notwithstanding its very low cost as compared with the chrysotile variety. The largest quantity of asbestos that has ever been produced in the United States in a single year is 1,200 tons. This production was obtained in 1882 and was valued at $36,000, or $30 per ton. In the table that follows there is given the annual production of asbestos in the United States and its value since 1880.

Annual production of asbestos, 1880–1903.

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	1903	887	16,760

When the figures of this table are compared with those of the following, which gives the value of the imports of asbestos into the United States, it will be seen how very small is this home production and how important it is to obtain in this country a supply of the chrysotile asbestos.

IMPORTS.

Nearly all of the asbestos imported into the United States is obtained from the Canadian deposits and is of the chrysotile variety. The value of the asbestos imported into the United States since 1869 is given in the table below:

Value of asbestos imported, 1869–1903.

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
				1903	657,269	32,058	689,327

As is seen from these two tables, the value of the asbestos imported into the United States in 1903, as compared with the home production, was as $689,327 is to $16,760, the value of the home production being about 2.4 per cent of the imports. The demand for an asbestos fiber of length sufficient for it to be used in spinning is really greater than the supply, though the supply of the short fiber readily keeps up with the demand.

PRODUCTION OF CANADIAN ASBESTOS.

As most of this importation of asbestos into the United States was from Canada, there is given in the following table the production of this mineral in that country:

Annual production of asbestos in Canada, 1879–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1879	300	$19,500	1892	6,042	$388,462
1880	380	24,700	1893	6,473	313,806
1881	540	35,100	1894	7,630	420,825
1882	810	52,650	1895	8,756	368,175
1883	955	68,750	1896	12,250	429,856
1884	1,141	75,079	1897	[a] 30,442	445,368
1885	2,440	142,441	1898	[a] 23,785	486,227
1886	3,458	206,251	1899	[a] 25,536	485,849
1887	4,619	226,976	1900	[a] 30,641	763,431
1888	4,404	255,007	1901	[a] 38,079	1,186,434
1889	6,113	426,554	1902	[b] 40,416	1,148,319
1890	9,860	1,260,240	1903	[c] 42,328	904,852
1891	9,279	999,978			

[a] Including asbestic. [b] Including 10,197 tons of asbestic. [c] Including 10,548 tons of asbestic.

This table shows a decrease in value of the production of 1903, as compared with that of 1902, although the tonnage was greater. This is due principally to the greater percentage of the second grade of asbestos obtained and to the larger amount of asbestic.

FLINT AND FELDSPAR.

By Heinrich Ries.

INTRODUCTION.

The figures of production show in some cases an increase, in others a decrease as compared with those of last year. The States from which the product was obtained were much the same as those in 1901, although several that were active in 1902 reported no production in 1903, as is shown in detail below.

FLINT.

PRODUCTION.

The production of flint or quartz in 1903 amounted to 40,046 short tons of crude flint, valued at $38,736, and 15,187 short tons of ground flint, valued at $118,211, a total of 55,233 short tons, valued at $156,947. This was an increase in production of 18,868 short tons, and in value of $12,738. The quarries of Wisconsin and Virginia were idle this year, as were also several in other States. 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. This is included only in those cases where the firm mining the flint grinds its own material.

Production of flint in the United States in 1903, by States.

State.	Crude.		Refined.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		Short tons.	
Connecticut	(a)	(a)	(c)	(c)
Maryland	(b)	(b)	15,187	118,211
New York	4,889	11,000	(c)	(c)
North Carolina	(b)	(b)		
Pennsylvania	35,157	27,736	(c)	(c)
Total	40,046	38,736	15,187	118,211

a Included under New York. b Included under Pennsylvania. c Included under Maryland.

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 value of the flints and flint stone, unground, imported in 1903, was $101,103.

The production of flint from 1892 to 1903 was as follows:

Production of flint in the United States, 1892-1903.

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	149,207
1902	20,295	35,046	16,070	109,163	36,365	144,209
1903	40,046	38,736	15,187	118,211	55,233	156,947

a Includes both crude and ground.

FELDSPAR.

PRODUCTION.

The production of feldspar in 1903 amounted to 13,432 short tons of crude feldspar, valued at $51,036, and 28,459 short tons of ground feldspar, valued at $205,697, a total of 41,891 short tons, valued at $256,733. This is a decrease from the total production of 1902 of 3,396 short tons, but an increase in value of $6,309. These figures do not show the entire amount of spar consumed in this country annually, for some is imported from Canada.

The production for 1903 is given below, the value of the crude material being that given at the mines, and of the refined that given at the mills when ground by the firm owning the mine.

Production of feldspar in the United States in 1903, by States.

State.	Crude.		Refined.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Connecticut	(a)	(a)	7,435	$55,628
Maine	(a)	(a)	(b)	(b)
Maryland	3,643	$13,079	11,958	71,560
New York	5,304	23,561	(b)	(b)
Pennsylvania	4,485	14,396	9,066	78,509
Total	13,432	51,036	28,459	205,697

a Included under New York.
b Included under Pennsylvania.

The production of feldspar from 1892 to 1903 is as follows. The figures since 1895 represent information collected directly by the Geological Survey, and are more approximately correct than those for preceding years:

Production of feldspar, 1892–1903.

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
1903	13,432	51,036	28,459	205,697	41,891	256,733

a Includes both crude and ground.

GRAPHITE.

By Joseph Hyde Pratt.

INTRODUCTION.

There are three distinct varieties of graphite on the market—crystalline, amorphous, and artificial. These are used to some extent for the same purpose, but there are some uses to which each is especially applied. Of the two natural forms of graphite the crystalline is the more valuable, and is usually a purer grade of graphite, being worth about $70 per ton, while the amorphous is only worth about $15 per ton. The artificial graphite averages still higher in value, about $92 per ton, this being due to the particular form in which some of it is produced.

Crystalline graphite.—This variety can be used for all purposes for which graphite is required, but its chief uses are in the manufacture of refractory products, lubricants, electrotypes, and pencils, for which it is especially adapted on account of its purity. It has been estimated that of all the crystalline graphite consumed in the country, 55 per cent was for crucibles, 15 per cent for stove polish, 10 per cent for foundry facings, 5 per cent for paint, and 15 per cent for all other purposes, including pencils, powder glazing, electrotyping, steam packing, and various other minor uses.[a] The coarser and purer form of the crystalline graphite is used for the manufacture of crucibles, pencils, lubricants, and electrotypes, and is known on the market as lump graphite and chip graphite, the former being more valuable. For the other purposes, as in the manufacture of stove polish, foundry facings, paints, etc., those grades of crystalline graphite known as dust and sweepings, are used, the dust having the higher price.

The bulk of the world's supply of crystalline graphite is obtained from the island of Ceylon. Masses of graphite have been found that weighed several hundred pounds. In the United States crystalline graphite is obtained principally from Essex and Washington counties, N. Y., and from Chester County, Pa., with smaller amounts from Coosa and Clay counties, Ala. In Colfax County, N. Mex., and Albany County, Wyo., there are deposits of graphite varying from

[a] Mineral Resources U. S. for 1902; U. S. Geol. Survey, 1904, p. 975.

semicrystalline to crystalline that are being developed and mined to a limited extent.

The refining of crystalline graphite is accomplished with but little difficulty, and the resultant product is usually very pure and free from any injurious compound. In some instances masses of the crystalline graphite are obtained that need no refining, and are ready for the crusher after simply being hand-cobbed.

Amorphous graphite.—The occurrences of amorphous graphite are very much more abundant than those of the crystalline variety, but on account of the difficulty experienced in refining the crude ore, many of these deposits are not at the present time of commercial value. There are still others that are so isolated from railroad transportation facilities that it is impracticable to attempt to work them. Schists are often impregnated with graphite to such an extent that they become graphitic schists, and they have been observed extending over a number of miles of territory. Usually these schists contain also minute particles of quartz (silica), and although they may carry a very high percentage of graphite, it is impossible in many cases to obtain commercially a pure and marketable graphite. This is due partly to the intricate manner in which the grains of quartz and graphite are intermingled, which makes it almost impossible to separate the quartz completely from the graphite, even by extremely fine crushing. Then again graphite and mica are found lying in parallel positions, so that it is almost impossible to separate the foliae of one mineral from those of the other. In some instances the deposits of graphite are worked on a limited scale, and the production is shipped directly as mined for use for foundry facings and paints.

The greater part of the world's supply of amorphous graphite is obtained from Austria-Hungary.

In the United States supplies of this variety of graphite are obtained principally from Providence County, R. I., and Baraga County, Mich., with smaller amounts from Sonoma County, Cal.; Barton County, Ga.; Wake County, N. C.; Lawrence and Pennington counties, S. Dak.; Portage County, Wis., and Ormsby County, Nev. A new deposit of graphite has recently been reported 3 miles east of Bossburg, Wash., on Kelly Hill, in the Parnell group, but little work has been done as yet to determine the extent of the deposit. There are large quantities of the amorphous graphite used in the manufacture of paints and for foundry facings. Some is also used in the manufacture of crucibles. The difficulty of purification of the amorphous graphite prevents its use for the manufacture of lubricants, the better quality of pencils, electrotypes, etc., except in a few instances, as in the case of some of that obtained from Bavaria and Mexico, and from one or two places in the United States.

Artificial graphite.—Methods for the production of artificial graphite have been known for a great many years, but it is only within the last eight years that a method has been devised for manufacturing it commercially. The three principal methods by which artificial graphite have been made are: (1) By heating amorphous carbon to a very high temperature in the electric furnace. (2) By dissolving an excess of carbon in a molten metal at a high temperature; on allowing the metal to cool down the excess of carbon separates out as graphite. (3) By the dissociation of certain carbon compounds by means of metallic iron, or iron oxide, at high temperatures. The method now employed in the manufacture of artificial graphite was discovered by Mr. E. G. Acheson, who also discovered carborundum. Mr. Acheson defines his method of manufacture as follows:[a]

This method of manufacturing graphite I would define as consisting in heating carbon, in association with one or more oxides, to a temperature sufficiently high to cause a chemical reaction between the constituents, and then continuing the heating until the combined carbon separates in the free state. It is not, however, limited to the use of oxides, as pure metals, their sulphides and other salts may be used, but for various reasons the oxides are to be preferred.

This process was first patented in 1896, United States patent No. 568323, entitled "Manufacture of Graphite," having been issued to Mr. Acheson. This patent reads partly as follows:

I have also discovered that in order to produce pure graphite from carbonaceous materials there is an indirect conversion, and that the act of the formation of the graphite is more in the nature of an act of dissociation of the carbon from its combination with other materials than a conversion of the ordinary carbon into graphite, and that, as a preliminary step, the carbon has to be combined chemically with some other material. Thus, I have found that if the carbonaceous material or carbon used in the process contains a considerable proportion of mineral matter, or if it is mixed with a certain proportion of oxide or oxides, such as silica, clay, alumina, manganese, lime, or oxide of iron, and subjected to the treatment as hereinafter set forth, the yield of graphite is enormously increased and the product is most satisfactory.

As is seen from the preceding extract the preparation of the artificial graphite is not made directly from the carbonaceous material, but by its conversion first into a carbide and its subsequent dissociation into graphite.

The first use made of the Acheson process was in the manufacture of electrodes for use in electrolytic processes. Now, however, it is manufactured on a large scale, and sold for many of the purposes for which crystalline graphite is used.

EXAMINATION OF GRAPHITE DEPOSITS.

On account of the constant increase in the demand for graphite, and of the fact that there is from six to ten times as much graphite imported into the United States as there is mined in this country, there is a great deal of interest aroused over the discovery of any large deposit of this mineral, especially of the crystalline

[a] Jour. Frank. Inst., June, 1899.

variety. Any deposit of this mineral within reasonable distance of railroad transportation is worthy of investigation. There are, however, a number of points to be taken into consideration in estimating the value of a graphite deposit, beside its location and cost of mining, which are: (1) Its variety, crystalline or amorphous. (2) The percentage of graphite in the ore. (3) The impurities that contaminate the ore, as mica, quartz, iron oxide, clay, etc. (4) Whether these impurities can be eliminated commercially. (5) The purpose for which the cleaned graphite can be used. Although it is important to know accurately the percentage of graphite that an ore carries, this is not of the first importance. It is very essential to determine whether or not the graphite ore can be so cleaned and refined as to produce a marketable product, and this should be determined before any large amount has been spent in the development of the deposit.

DETERMINATION OF GRAPHITE IN AN ORE.

In estimating the percentage of graphite in an ore, the customary method is to burn off the particles of graphite from a given quantity in a weighed crucible. This, however, is open to error unless allowance is made for the moisture and organic matter that the sample may contain. A method recently described by Mr. J. Dunraven Young[a] is as follows:

Mix one-half gram of high-grade graphite (or 1 gram low-grade graphite) with 1 gram of finely pulverized wood charcoal and transfer without loss to a weighed platinum crucible and burn, occasionally stirring the contents of the crucible with a platinum wire. The combustion will be completed in thirty to sixty minutes. The crucible and contents, after being cooled, are weighed. This residue will consist of the nonvolatile matter of the graphite, together with the ash of 1 gram of charcoal.

Next determine the ash in 1 gram of charcoal by the usual method of burning in a platinum crucible. The weight of the ash of the charcoal is then deducted from the above residue, the difference being the weight of the nonvolatile matter present in the weight of graphite taken. If the weight of this residue, thus corrected, is deducted from the weight of graphite taken, the difference, which is the loss on ignition, will represent the weight of graphitic carbon, provided no volatile matter is present. In general the results thus obtained will not be reliable unless the following correction is applied:

Into a weighed platinum crucible put 1 gram of the graphite, close the crucible very tightly with the cover and set the latter upright on a clay triangle. Next heat the crucible for three to five minutes, giving it the highest temperature attainable with a good Bunsen burner, and allowing the flame to pass around the crucible on all sides. Then cool the crucible in the desiccator and weigh. The loss in weight represents the volatile noncombustible matter in 1 gram of graphitic rock. This "loss on ignition in closed crucible" must be added to the weight of the nonvolatile residue or subtracted from the weight of the graphitic carbon as obtained above. The results so obtained are very accurate if the gangue matter consists only of quartz, clay, silicates, carbonates, or volatile organic matter. The results are not reliable if sulphurets are present. If such is the case it will be necessary to select one of the other methods for estimating graphitic carbon.

[a] The Mining World, July 18, 1903.

PRODUCTION.

The value of the total production of graphite in the United States during 1903 was $225,554, as compared with the total value of $182,108 in 1902. This is an increase of $43,446 in value, which was due almost entirely to the increase in the value of the production of the amorphous graphite.

Crystalline graphite.—The production of crystalline graphite in the United States during 1903 amounted to 4,538,155 pounds, valued at $154,170, which is an increase of 601,331 pounds in quantity and of $28,026 in value as compared with the production of 3,936,824 pounds, valued at $126,144, in 1902. In 1903 there were about 1,000,000 pounds sold in the crude state, a considerably larger quantity than was sold in the crude state in 1902. There would have been a still larger increase in the 1903 production if the mill of the Federal Graphite Company, in Chester County, Pa., had not been destroyed by fire early in 1903. It has been rebuilt, but was not completed until late in the fall. This caused a very decided decrease in the Pennsylvania production.

The average price per pound received for the 1903 product was 3⅖ cents, which is one-fifth of a cent higher than the average price received per pound in 1902.

The States from which this production of crystalline graphite was made are given in the order of the value of their production, as follows: New York, Alabama, Pennsylvania, New Mexico, and Wyoming.

Amorphous graphite.—There was a very large increase in the production of amorphous graphite in 1903. The production amounted to 16,591 short tons, valued at $71,384, or $4.30 per ton, an increase of 11,852 tons in quantity and of $15,420 in value as compared with the production of 4,739 short tons, valued at $55,964, or $11.81 per ton, in 1902. This very large increase is due to the development of the Georgia deposits, whose product was put on the market in large quantity, but at a very low price, which accounts for the great variation in the average price per ton received for the 1902 and the 1903 productions, a difference of $7.52 per ton. The Georgia product was not used for any of the purposes for which graphite is ordinarily mined.

The 1903 production of amorphous graphite was obtained from the following States, given in the order of the value of their production: Georgia, Wisconsin, Michigan, Rhode Island, South Dakota, California, Nevada, and North Carolina.

The price per ton received for the product in the various States varied from $2 per ton for the Georgia graphite to $30 per ton for the South Dakota graphite.

The following table shows the annual production of graphite from

1880 to 1903, inclusive, the refined crystalline product being given in pounds and the amorphous in tons:

Production of natural graphite, 1880–1903.

Year.	Quantity.	Value.
1880 .... pounds..	622,500	$49,800
1881 .... do....	400,000	30,000
1882 .... do....	425,000	34,000
1883 .... do....	575,000	46,000
1884 .... do....	500,000	35,000
1885 .... do....	327,883	26,231
1886 .... do....	415,525	33,242
1887 .... do....	416,000	34,000
1888 .... do....	400,000	33,000
1889	....	72,662
1890	....	77,500
1891 .... pounds..	1,559,674	110,000
1892 .... do....	1,398,365	87,902
1893 .... do....	843,103	63,232
1894 .... do....	918,000	64,010
1895 .... pounds.....	644,700	52,582
short tons..	2,793	
1896 .... pounds.....	535,858	$48,460
short tons..	760	
1897 .... pounds.....	1,361,706	65,730
short tons..	1,070	
1898 .... pounds.....	2,360,000	75,200
short tons..	890	
1899 .... pounds.....	2,900,732	167,106
short tons..	2,324	
1900 .... pounds.....	5,507,855	197,579
short tons..	611	
1901 .... pounds.....	3,967,612	167,714
short tons..	809	
1902 .... pounds.....	3,936,824	182,106
short tons..	4,739	
1903 .... pounds.....	4,538,155	225,554
short tons..	16,591	

Artificial graphite.—There has been an almost constant increase in the production of artificial graphite since its introduction on the market in 1897. The quantity of this variety of graphite that was manufactured in 1903 amounted to 2,620,000 pounds valued at $178,670, which is the largest quantity produced in any year. This is an increase of 261,172 pounds in quantity and of $67,970 in value, as compared with the 1902 production of 2,358,828 pounds valued at $110,700. The average price per pound received for the 1903 product was 6.82 cents, an increase of 2.13 cents over the price, 4.69 cents per pound, received for the 1902 product.

When this value, $178,670, of the 1903 production of the artificial graphite is compared with the value, $225,154, of the 1903 production of natural graphite, which is only $46,484 greater, it is at once recognized that artificial graphite has assumed a very important position in the graphite industry. In the table following are given the quantity and the value of the graphite manufactured for each year since 1897.

Production and value of artificial graphite, 1897–1903.

Year.	Quantity.	Value.*	Unit value per pound.
	Pounds.		*Cents.*
1897	162,382	$10,149	6.25
1898	185,647	11,603	6.25
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
1903	2,620,000	178,670	6.82

IMPORTS AND EXPORTS.

The annual importation of graphite into the United States each year far exceeds the domestic production, and in 1903 the value of the imports was $1,207,730, as compared with $1,168,554, the value of the graphite imported in 1902. Since the statistics of the production of graphite in the United States were first collected there has been no year in which the value of the imports has not greatly exceeded the value of the domestic production. For the last few years there has been a small amount of graphite exported, which in 1903 was valued at $13,365, as compared with 12 tons valued at $834 in 1902, and with 5 tons valued at $365 in 1901.

In the following table are given the quantity and the value of the graphite imported into the United States from 1867 to 1903, inclusive:

Graphite imported into the United States, 1867-1903.

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
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	18,201	1,168,554		1,168,554
1903	16,007	1,207,730		1,207,730

ANNUAL CONSUMPTION OF GRAPHITE.

In order to show more clearly the actual quantity of graphite that is consumed in the United States each year, there are given in the following table the quantity and value of the production of the natural and artificial graphites, and the imports:

Annual consumption of graphite in the United States, 1899–1903.

Year.	Natural graphite.		Artificial graphite.		Imports.		Exports.		Total, less exports.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
1899	3,774	$167,106	203	$32,475	23,288	$1,990,649	....	....	27,265	$2,190,230
1900	3,365	197,579	430	68,860	16,147	1,390,141	....	....	19,942	1,656,580
1901	2,793	167,714	1,250	119,000	16,044	895,010	6	$365	20,081	1,181,359
1902	6,707	182,108	1,179	110,700	20,385	1,168,554	13	834	28,258	1,460,528
1903	18,820	225,554	1,310	178,670	17,628	1,207,730	....	13,365	37,758	1,598,589

The importance of the graphite industry in the United States is well emphasized by this table, and also the benefit that would be derived by this country if large deposits of commercial graphite could be found. There is a general increase in the quantity of graphite consumed, although there has been a very wide variation in the value of the production each year.

CANADIAN PRODUCTION.

The production of graphite in Canada is obtained chiefly from the provinces of Quebec and Ontario, with smaller amounts from New Brunswick and Nova Scotia. In 1903 the quantity of graphite produced was 738 short tons, valued at $23,745, as compared with a production of 1,095 tons, valued at $28,300, in 1902. The following table gives the quantity and value of the annual production of graphite in Canada from 1886 to 1903, inclusive:

Annual production of graphite in Canada, 1886–1903.

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)	13,696
1890	175	5,200	1899	1,310	24,179
1891	260	1,560	1900	1,922	31,040
1892	167	3,763	1901	2,210	38,780
1893	None.	None.	1902	1,095	28,300
1894	691	223	1903	738	23,745

a Quantity not reported.

WORLD'S PRODUCTION.

In the following table is shown the world's production of graphite, by countries, from 1896 to 1902, inclusive:

World's production of graphite, 1896–1902.

[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	9,248,263
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	18,287
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.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	3,774	$167,106	3,054	$197,579	2,583	$167,714	6,085	$182,108
Austria	31,819	395,280	33,663	418,126	29,992	369,157	29,527	368,186
Canada	1,188	24,179	1,744	31,040	2,005	38,780	994	28,300
Ceylon	29,037	2,904,970	19,168	[a] 875,190	22,707	[a] 3,208,215	25,593	3,505,455
France	....	....	....	....	....	....	150	1,140
Germany	5,196	120,250	9,248	136,500	4,435	58,000	5,023	41,755
India	1,548	7,572	1,858	9,104	2,530	(b)	4,648	(b)
Italy	9,990	55,944	9,720	55,720	10,313	59,211	9,210	35,934
Japan	58	5,120	94	12,215	88	8,930	(b)	....
Mexico	2,306	22,847	2,561	25,650	1,473	7,385	580	3,176
Sweden	[c] 585	1,674	84	3,186	56	1,900	63	1,900
Total	85,445	3,704,942	81,194	1,764,810	76,226	[d] 3,930,359	81,873	4,167,954

[a] These values were taken from the official year books of the United Kingdom.
[b] Statistics not available.
[c] Includes crude.
[d] Latest available figures used in making up total.

MAGNESITE.

By Charles G. Yale.

PRODUCTION.

The mineral magnesite is a native carbonate of magnesia, composed of magnesia (MgO) 47.6 per cent, and carbon dioxide (CO_2) 52.4 per cent. There is often combined with it a small quantity of magnesium silicate and iron carbonate. The production in the United States continues to be entirely from California, and during 1903 the quantity reported was 3,744 short tons crude, valued at $10,595, equivalent to 1,361 tons calcined, worth $20,515. The production of California in 1902 was, according to revised and corrected figures, 2,830 tons crude, valued at $8,490, and in 1901 the revised figures show 3,500 tons crude, valued at $10,500.

The following table gives the quantity and value of crude magnesite produced in the United States from 1891 to 1903, inclusive:

Quantity and value of crude magnesite produced in the United States, 1891–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1891	439	$4,390	1898	1,263	$19,075
1892	1,004	10,040	1899	1,280	18,480
1893	704	7,040	1900	2,252	19,333
1894	1,440	10,240	1901	3,500	10,500
1895	2,220	17,000	1902	2,830	8,490
1896	1,500	11,000	1903	3,744	10,595
1897	1,143	13,671			

These prices are for the crude or raw material on board the cars at the mines, freight not included. The value of the calcined is, of course, greater.

The production of crude magnesite is practically in the hands of one firm at present. The crude is sent to the manufacturers of carbonic-acid gas by calcination, and the calcined product is used by the paper mills. The demand for both crude and calcined is limited on the Pacific coast, and, owing to a freight rate of $13 to $15 per ton on shipments to eastern points, it is not shipped out of California except to the paper mills in Oregon. The production of California could be quadrupled, if the demands of consumption warranted the increase.

The imports of magnesite into the United States in 1903 were as follows:

Imports of magnesite into the United States in 1903.

	Quantity.	Value.
Magnesia:	*Pounds.*	
Calcined, medicinal	34,586	$4,412
Carbonate of, medicinal	10,569	765
Sulphate of, or Epsom salts	2,392,831	11,326
Magnesite:		
Calcined, not purified	73,534,690	311,396
Crude	36,017,637	150,002

In addition, magnesium, not made up into articles, was imported to the value of $7,294. Most of the imports came from Greece, though some came from Austria. From these figures it will be seen that the United States furnishes a very small part of the total quantity consumed in this country. Most of the Grecian magnesite comes from the island of Eubœa, and is of fine quality. In the crude state it sometimes analyzes as high as 98 per cent magnesium carbonate, but more often averages between 94 and 96 per cent magnesium carbonate, 0.08 per cent ferric oxide, 0.52 per cent silica, and 0.54 per cent water. Calcined at dead heat for refractory purposes, the mineral analyzes from 82.46 to 96.25 per cent magnesia; 0.85 to 10.92 per cent lime; 0.56 to 3.54 per cent ferric oxide and alumina; and 0.73 to 7.98 per cent silica. Variations are due to the quality of the crude product burned.

USES.

In the crude state magnesite is used for the manufacture of carbon-dioxide gas; calcined it is used in the manufacture of paper from wood pulp; and as a refractory material in brick or concrete form for lining furnaces, covering steam pipes, as artificial lumber, as composite stone for lithographing, etc. The magnesia chloride is an excellent bleaching agent.

The calcined magnesite, generally in the form of brick, is now universally recognized as the best material for lining basic open-hearth furnaces, cement kilns, etc. It may be employed to advantage wherever high temperatures and chemical reactions are usually detrimental to dolomite, chromite, and silica brick. The distinctive characteristics of a magnesite lining are durability, freedom from moisture and silicic acid, and resistance to corrosion when exposed to the action of basic slags and metallic oxides. These qualities make the lining cheaper than most others in the long run. The Mountain Copper Company of Keswick, Cal., pays as high as $220 per thousand for the German magnesite brick for furnace lining, free on board at New York. At that point the calcined sells at $20 per ton, and the very best, imported in steel cylinders, is as high as $100 per ton. The crude Grecian magnesite brings about $5.50 per ton on the wharf at New York. Thus far no magnesite bricks have been made in California, though a factory for the purpose is shortly to begin operations at Oakland. The bricks made in this country come from the Fayette Manufacturing Company of Layton, Pa., and the Harbison-Walker Refractories Company, Pittsburg.

In the manufacture of carbonic-acid gas, the gas is extracted from the magnesite by calcining and the remaining calcined material is sold to the manufacturers of wood-pulp paper. The best English coke is used for calcining the magnesite. From one short ton of magnesite, after removing the gas, they obtain about 1,200 pounds of residue, which is partly calcined magnesite still carrying some 20 per cent of gas. In the process about 500 pounds of gas is obtained, when finally compressed into liquid form. For every ton of magnesite about 500 pounds of coke is burned, and this, containing about 97 per cent of carbon, also furnishes considerable gas. The steel cylinders for holding the liquid gas are three-sixteenths inch thick and 5 by 49 inches long, and hold about 25 pounds. The pressure on the cylinder at 60° F. is about 850 pounds, a three-stage compressor being used. In shipping the liquid gas through the central valleys and to Arizona the heat in the cars sometimes runs as high as 145°, the pressure being increased thereby. The cylinders containing the liquefied gas are shipped to soda-water manufacturers, ice factories, refrigerating plants, breweries, bar rooms, etc. The cylinders with the liquid gas are shipped all over the Pacific coast from San Francisco, even the British war vessels stationed at British Columbia using the gas for their refrigerating plants. The San Francisco carbonic acid gas makers use about 1,000 tons of crude magnesite annually.

As stated, the wood pulp paper mills of California and Oregon use the calcined magnesite. They transform it into a sulphite of magnesia and use it as a digester for the wood pulp. To make this sulphite they put the material into a tank and pass sulphurous fumes through it. After being used as a digester they add a little lime and make the "pearl hardening" of commerce as a "filler" for the paper.

OCCURRENCE.

Aside from Greece and Austria, magnesite is found in Silesia, Germany; Minsau, Hungary; in Swedish Lapland; the Ural Mountains in Russia; in Quebec, Canada; and in India. Magnesite occurs in the United States in Massachusetts, Maryland, Pennsylvania, and California, but only in the latter State have the deposits been commercially utilized. The principal producing point in California is in the vicinity of Porterville, Tulare County, though a small quantity still comes from Chiles Valley and Pope Valley, Napa County. At Porterville there are several deposits. The main deposit at the opening carries a small vein, but at the end of the 240-foot tunnel the deposit is 40 feet wide, and there are said to be several million tons now in sight. At this place calcining furnaces have been erected and are in operation. The mineral crops out boldly in distinct veins, having a general strike northeast and southwest, and there are spurs running in several instances at nearly right angles with the primary veins. On the surface the veins are from 2 inches to 10 feet wide. They cover an area of over 500 acres. In Pope and Chiles valleys, Napa County, there are somewhat extensive deposits, which were formerly worked; but hauling by team to railroad made them more expensive to operate than the mines at Porterville. In Placer County there is a more extensive deposit than elsewhere in California, but it is in an almost inaccessible mountain region where a very costly road would be necessary to get the product out, and the deposit has therefore not been utilized. Near Sanger, Fresno County, 7 miles from Centerville, is another deposit now being opened. A deposit has been discovered also near Walkers Pass, Kern County, but it has never been opened. There are also unutilized deposits near Morgan Hill, Santa Clara County.

The extensive deposits of magnesite on Red Mountain, at a point where Stanislaus, Alameda, and Santa Clara counties join, are now being opened by the American Magnesite Company, of Chicago, which has obtained control of the numerous claims heretofore owned by individuals. None of them have been at all thoroughly prospected as yet, though there are numerous bowlders or large croppings, some from 30 to 150 feet wide, supposed to cover extensive beds beneath. The parent company is the American Magnesite Company, organized under the laws of the State of Maine, with Mr. G. Watson French of Chicago, as president, and Mr. H. C. Stillwell, of Fruitvale, Alameda County, Cal., as vice-president and Pacific coast agent; Mr. Charles H. Spinks, of Berkeley, Cal., is to manage the mines. One of the subsidiary companies is the Rose Brick Company, which is to manufacture magnesite brick, at Oakland, Cal.; the American Carbonic Acid Gas Company is another, of which Mr. John Deere is president and Mr. George A. Wayman manager. The third corporation is the Plastic Construction Company, of which Mr. Edwin D. Weary, of Chicago, is president. This company controls the American rights for making a fireproof construction material as well as a patent brick. This factory will also be in Oakland.

The mines of this company are nearly all in Santa Clara County, with a few in Stanislaus, near the Alameda County line. The Alameda County supervisors are building a wagon road from the mines to Livermore, where the railroad is met. There are twenty-seven mining claims in the group, and several are at present being opened. Only a few carloads for sample purposes have been shipped since the completion of the new organization, but it is expected that the properties will shortly be opened on an extensive scale.

MINERAL WATERS.

PRODUCTION.

So far as shown by the reports received for the year 1903, there is a decided loss in the number of gallons of water sold, with a slight increase in the value of the product. This loss is shown in all sections of the country but two. It is due mainly to the fact that many important springs failed to report for the year 1903, although they sent in returns for the previous year. Many springs, principally used as sources of table waters, however, have been abandoned commercially during the past year, the waters being no longer put upon the market owing to improvement in the sources of public water supplies. The list for 1903 is slightly increased over that of 1902, including now 725 springs instead of 721 as in 1902, a gain of 4. There have been added to the list 42 springs, and 38 have been dropped from it, mainly because they have been commercially abandoned, with little prospect of being utilized in the future.

The springs actually reporting sales for 1903 number 560, which is 89 less than the number reporting in 1902. The springs not heard from number 129, and these with few exceptions reported sales in 1902. Estimates based on previous reports have been included for these springs. To these must be added 36 springs which report that no sales were made in 1903, making a total of 165 for the delinquent list. The average price per gallon is about 17 cents for 1903, as compared with 13.7 cents for 1902.

The total production for 1903, including the figures estimated for the delinquent springs, is 51,242,757 gallons, at a valuation of $9,041,078, a loss in quantity of 13,616,694 gallons, and a gain in value of product of $247,317, as compared with 1902. When the 560 springs actually reporting are alone considered, the figures are 40,107,147 gallons, as compared with 63,174,552 gallons in 1902, a loss of 23,067,405 gallons; and the valuation for 1903 becomes $6,788,426, compared with $8,634,179 in 1902, a loss of $1,845,753. It is probable that a loss in product would be shown even had all the springs now delinquent sent in returns.

With reference first to the North Atlantic States, the reports show a loss of 8 springs, the total for 1903 being 249 instead of 257 as in 1902; for although 9 springs were added, 17 were dropped from the list. Reports of sales were received from only 202 springs, the delinquent list numbering 47. The number of gallons sold in 1903 is reported as 11,198,550 a loss of 10,848,713 gallons as compared with

1902; and the value of this product was $2,552,626, a loss of $987,807. The 9 springs new to the list are the following:

Connecticut.—Pequabuck Mountain Spring.

Maine.—Indian Hermit Spring, Puritan Spring, Wawa Lithia Spring.

New York.—Washington Lithia Spring, of Ballston Spa.

Pennsylvania.—Bedford White Sulphur Spring, Granny Coon Spring, Minnequa Springs.

Vermont.—Alburg Chalybeate Lithia and Sulphur Springs.

For the South Atlantic States the list gains 2 springs, the total for 1903 being 118, as 6 springs were added to it and 4 were dropped. Sales for 1903 were reported by 77 springs. The number of gallons sold is 4,524,517, which is a gain of 484,315 gallons over 1902, and the $771,373, a gain of $101,019. The 6 springs not on the list of 1902 are the following:

South Carolina.—Cherokee Springs.

Virginia.—Alleghany Springs, Bedford Alum Spring, Wyrick's Lithia Spring.

West Virginia—Borland Mineral Well, Greenbrier (Barger's) Springs.

The North Central States show a net gain of 6 springs, 15 having been added and 9 dropped from the list. Of the total of 180 credited to the section, 144 report sales for 1903. The production of 1903 is 17,143,946 gallons, valued at $2,208,212, a decrease from 1902 of 8,114,272 gallons and of $630,286. The springs new to the list, 15 in number, are the following:

Indiana.—Blue Cast Magnetic Spring, Coats's Spring, Hunter Mineral Spring, Lily White Sulphur Springs, Paoli Lithia Spring, La Salle Springs, Winamac Artesian Well.

Kansas.—Arrington Mineral Springs.

Michigan.—Sanitas Spring.

Missouri.—Crystal Lithium Spring, Cusenburg Springs, Ionian Lithium Spring, Kalikat Bitter Water Spring, Montesano Springs.

Wisconsin.—New Saratoga Spring.

In the South Central States there is a net gain of 4 springs, 6 having been added to the list of 1902 and 2 dropped from it. Of the 77 springs credited to the section, 63 report sales for 1903. The number of gallons reported sold is 2,929,009, which is 5,261,816 less than the production of 1902. The value of the product of 1903 is $276,468, or $349,024 less than that of the previous year. The 6 springs new to the list are the following:

Arkansas.—Mountain Valley Springs.

Kentucky.—Hamby Salts Iron and Lithia Well.

Mississippi.—Tallaha Springs.

Tennessee.—Tillman Spring.

Texas.—Marlin Hot Well, Specific Well of Mineral Wells.

The Western States and Territories show no change in the number of springs credited to the section, as 6 springs were added to the list and 6 dropped from it, the total therefore remaining at 95, and yet this is one of the two sections that shows an increase in production and value. Sales are reported from 74 springs, the figures being 4,311,125 gallons, valued at $979,747, an increase of 673,081 gallons in quantity and of $20,345 in value over 1902. The 6 springs new to the list are the following:

Arizona.—Aqua Caliente, Arizona Medical Spring, Castle Creek Hot Springs.
Colorado.—Blue Ribbon Springs.
Oregon.—Lake View Hot Spring.
Wyoming.—Rawlins Sulphur Springs.

Production of mineral waters in 1903, by States and Territories.

State or Territory.	Springs reporting.	Quantity.	Value.
		Gallons.	
Alabama	6	68,784	$27,660
Arizona	3	1,550	240
Arkansas	8	444,100	53,475
California	34	1,862,855	706,372
Colorado	12	817,300	127,078
Connecticut	12	175,900	19,302
District of Columbia	2	258,000	13,050
Florida	2	10,450	5,072
Georgia	5	379,517	65,252
Illinois	20	1,118,240	149,978
Indiana	19	392,582	303,618
Kansas	16	2,654,961	274,908
Kentucky	5	295,000	29,630
Louisiana	3	483,516	45,187
Maine	24	612,381	92,714
Maryland	9	511,940	45,918
Massachusetts	64	5,931,262	243,671
Michigan	19	6,919,107	200,668
Minnesota	4	2,228,000	46,470
Mississippi	6	348,119	28,956
Missouri	19	907,550	53,190
Montana	2	1,242,550	37,425
New Hampshire	5	579,000	194,700
New Jersey	12	327,000	34,610
New Mexico	7	79,000	22,350
New York	48	1,827,408	1,482,801
North Carolina	9	83,100	130,085
Ohio	18	1,389,959	91,107
Oregon	8	37,370	6,861
Pennsylvania	29	1,522,860	357,579
Rhode Island	3	165,739	6,899
South Carolina	3	127,768	5,100
South Dakota	2	239,470	29,287
Tennessee	13	339,100	34,647
Texas	21	939,390	53,613
Vermont	5	57,000	19,350
Virginia	41	2,561,502	477,410
Washington	3	55,000	10,550
West Virginia	6	592,240	29,486
Wisconsin	26	1,293,777	1,058,964
Other States [a]	5	226,800	72,201
Total	560	40,107,147	6,788,426
Estimated production of springs not reporting sales	165	11,135,610	2,252,652
Grand total	725	51,242,757	9,041,078

[a] The States in which only one spring each has made a report are included here. These States are Idaho, Iowa, Indian Territory, Utah, and Wyoming.

Production of natural mineral waters, 1883–1903.

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	1,485,809	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	192,606
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	206,217
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
1888.			
North Atlantic	42	2,856,799	247,108
South Atlantic	32	1,689,387	493,489
North Central	38	2,002,373	325,880

Production of natural mineral waters, 1883-1903—Continued.

Geographic division.	Springs reporting.	Quantity sold.	Value.
1888—Continued.		*Gallons.*	
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	198,082
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
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

Production of natural mineral waters, 1883–1903—Continued.

Geographic division.	Springs reporting.	Quantity sold.	Value.
1894.		*Gallons.*	
North Atlantic	83	8,217,528	$1,486,361
South Atlantic	55	660,120	129,143
North Central	82	6,914,900	1,115,322
South Central	87	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	400,406
North Central	97	8,123,080	806,307
South Central	34	4,364,957	256,943
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	3,268,915
South Atlantic	71	5,073,941	3,165,171
North Central	107	7,499,563	896,158
South Central	35	1,253,517	93,437
Western	62	2,693,318	482,817
	406	27,681,639	7,926,498
Estimated	76	1,171,825	125,340
Total	484	28,853,464	8,051,838

Production of natural mineral waters, 1883–1903—Continued.

Geographic division.	Springs reporting.	Quantity sold.	Value.
1899.		*Gallons.*	
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
1903.			
North Atlantic	202	11,198,550	2,552,626
South Atlantic	77	4,524,517	771,373
North Central	144	17,143,946	2,208,212
South Central	63	2,929,009	274,668
Western	74	4,311,125	979,747
	560	40,107,147	6,788,426
Estimated	165	11,135,610	2,252,652
Total	725	51,242,757	9,041,078

Summary of reports of mineral springs for 1903.

State or Territory.	Springs reporting.	Springs not reporting.	Total used commercially.
NORTH ATLANTIC STATES.			
Maine	24	4	28
New Hampshire	5	1	6
Vermont	5	2	7
Massachusetts	64	11	75
Rhode Island	3	1	4
Connecticut	12	3	15
New York	48	14	62
New Jersey	11	3	14
Pennsylvania	29	9	38
SOUTH ATLANTIC STATES.			
Maryland	9	0	9
District of Columbia	2	1	3
Virginia	41	17	58
West Virginia	6	5	11
North Carolina	9	3	12
South Carolina	3	7	10
Georgia	5	5	10
Florida	2	3	5
SOUTH CENTRAL STATES.			
Kentucky	5	1	6
Tennessee	13	1	14
Alabama	6	2	8
Mississippi	6	2	8
Louisiana	3	0	3
Texas	21	7	28
Arkansas	8	0	8
Oklahoma	0	1	1
Indian Territory	1	0	1
NORTH CENTRAL STATES.			
Ohio	18	4	22
Indiana	20	3	23
Illinois	19	2	21
Michigan	19	10	29
Wisconsin	26	11	37
Minnesota	4	1	5
Iowa	1	5	6
Missouri	19	4	23
South Dakota	2	0	2
Nebraska	0	1	1
Kansas	16	1	17
WESTERN STATES AND TERRITORIES.			
Wyoming	1	1	2
Montana	2	1	3
Colorado	15	5	19
New Mexico	6	1	7
Arizona	3	1	4
Utah	1	2	3
Nevada	0	1	1
Idaho	1	0	1
Oregon	8	1	9
Washington	3	1	4
California	34	8	42
Total	560	165	725

LIST OF COMMERCIAL SPRINGS.

The list following contains the names of those springs only that are represented in the figures given in the table of production; that is, only those reporting sales for the year 1903:

ALABAMA.

The list for Alabama for 1903 remains the same as for 1902. Of the 8 springs credited to the State the following 6 report sales:

Healing Springs, Healing Springs, Washington Count
Ingram Lithia Springs, Calhoun County.
MacGregor Springs, Spring Hill, Mobile County.
Talladega Springs, Talladega County.
Wilkinson's Matchless Mineral Wells, Greenville, Butler County.
York Aperient Springs, York, Sumter County.

ARIZONA.

Arizona's list gains 3 springs, which make the total 4. Of these, 3 report for 1903. They are:

Aqua Caliente, Maricopa County.
Arizona Medical Springs, Yavapai County.
Castle Creek Hot Springs, Yavapai County.

ARKANSAS.

To the list for Arkansas 1 spring is added, making a total of 8 for 1903. Of these, all report sales as follows:

Allen's Alterative Magnesia Spring, Hot Springs, Garland County.
Arkansas Lithia Springs, near Hope, Hempstead County.
Arsenic Spring, Hot Springs, Garland County.
Blanco Springs, near Hot Springs, Garland County.
Eureka Springs, Eureka Springs, Carroll County.
Mountain Valley Springs, near Hot Springs, Garland County.
Potash Sulphur Spring, near Hot Springs, Garland County.
Ravenden Springs, Ravenden Springs, Randolph County.

CALIFORNIA.

California loses 4 springs from the list, which leaves the total at 42. Of these, 34 report as follows:

Adams Springs, Lake County.
Ætna Springs, Pope Valley, Lidell, Napa County.
Alhambra Mineral Spring, Martinez, Contra Costa County.
Allen Springs, Allen Springs, Lake County.
Astorg Springs, Lake County.
Bartlett Springs, Bartlett Springs, Lake County.
Blairs Mineral Spring, near Mono Lake, Mono County.
Bradley Spring, near Ramono, San Diego County.

Buckman Springs, near Descanso, San Diego County.
Bythnia Springs, Santa Barbara, Santa Barbara County.
California Geysers, The Geysers, Sonoma County.
Castalian Springs, Sierra Nevada Mountains, Inyo County.
Castle Rock Natural Mineral Spring, Castella, Shasta County.
Cook Spring, near Williams, Colusa County.
Duncan Springs, Hopland, Mendocino County.
Eden Hot Springs, near San Jacinto, Riverside County.
Fouts Springs, Snow Mountain, Colusa County,
Highland Seltzer Spring, Highland Springs, Lake County.
Humboldt Artesian Springs, Eureka, Humboldt County.
Isham Springs, near San Diego, San Diego County.
Lytton Soda, Seltzer, and Carlsbad Springs, Lytton, Sonoma County.
Mercey Hot Mineral Spring, Little Panoche, Fresno County.
Mount Ida Mineral Spring, Oroville, Butte County.
Mount Shasta Springs, Shasta Springs, Siskiyou County.
Napa Soda Springs, Napa Soda Springs, Napa County.
Napa Vichy Springs, near Napa City, Napa County.
Pacific Congress Springs, Saratoga, Santa Clara County.
Paraiso Hot Springs, near Jamesburg, Monterey County.
Ramona Natural Mineral Spring, Los Angeles, Los Angeles County.
Tassajara Hot Springs, Monterey County.
Tolenas Springs, near Suisun, Solano County.
Tuscan Springs, Tuscan, Tehama County.
Veronica Springs, Santa Barbara, Santa Barbara County.
Witter Medical Spring, Witter, Lake County.

COLORADO.

Colorado loses 2 springs and gains 1, the total becoming 19 for 1903. Of these 15 report sales, as follows:

Blue Ribbon Spring, Idaho Springs, Clear Creek County.
Boulder Springs, Boulder Canyon, Boulder County.
Canyon City Vichy Springs, Canyon City, Fremont County.
Clark Magnetic Mineral Springs, near Pueblo, Pueblo County.
Colorado Carlsbad Springs, Barr, Arapahoe County.
Colorado Lithia Springs, Pueblo, Pueblo County.
Columbia Mineral Spring, Denver.
Glaze's Spring, near Olney, Otero County,
Golden Lithia Spring, Golden, Jefferson County.
Hot Soda Spring, Idaho Springs, Clear Creek County.
Navajo, Manitou, Cheyenne, and Shoshone Springs, Manitou, El Paso County.
The Dr. Horn Mineral Springs, Colorado Springs, El Paso County.
Ute Chief Mineral Spring, Manitou, El Paso County.
Ute Iron Springs, Manitou, El Paso County.
Yampah Spring, Glenwood Springs, Garfield County.

CONNECTICUT.

Connecticut gains 1 spring, which makes the total 15 for 1903. Of these 12 report sales in 1903. They are the following:

Arethusa Spring, Seymour, New Haven County.
Aspinock Mineral Springs, Putnam Heights, Windham County.
Cherry Hill Spring, Hamden, New Haven County.
Granite Rock Spring, Higganum, Middlesex County.

Highland Rock Spring, Highland Park, Hartford County.
Highland Tonica Springs, Highland Park, Hartford County.
Live Oak Spring, Meriden, New Haven County.
Oxford Mineral Spring, Oxford, New Haven County.
Park Spring, Willimantic, Windham County.
Pequabuck Mountain Spring, Bristol, Hartford County.
Puritan Spring, Norwich, New London County.
Stafford Mineral Spring, Stafford Springs, Tolland County.

DISTRICT OF COLUMBIA.

The District of Columbia loses 1 spring, which leaves the total at 3. Of these 2 report sales, as follows:

Crystal Spring, Washington.
Gitchie Crystal Spring, Benning.

FLORIDA.

Only 2 of the 5 springs credited to Florida report the sales of 1903. They are the following:

Magnolia Springs, Magnolia Springs, Clay County.
Orange City Mineral Spring, Orange City, Volusia County.

GEORGIA.

Although 10 springs are credited to Georgia only half of them report the sales of 1903. The 5 that send reports are the following:

Artesian Lithia Well, Austell, Cobb County.
Bowden Lithia Springs, Lithia Springs, Douglas County.
Hughes Mineral Springs, near Rome, Floyd County.
Ponce de Leon Spring, near Atlanta, Fulton County.
Lith-Aris Spring, formerly Sulpho-Magnesia Lithia Spring, near Austell, Cobb County.

IDAHO.

There is no change in the list for Idaho. The 1 spring credited to the State reports sales in 1903. It is the following:

Idanha Natural Lithia Spring, Soda Springs, Bannock County.

ILLINOIS.

There is a loss of 2 springs for Illinois, the total being 21, and of these 19 report sales for 1903, as follows:

Abana Spring, Libertyville, Lake County.
Aqua Vitæ Mineral Springs, near Maquon, Knox County.
Aurora Lithia Spring, Montgomery, Kane County.
Black Hawk Springs, Rock Island, Rock Island County.
Blue Grass Springs, Montgomery, Kane County.
Cumberland Mineral Spring, near Greenup, Cumberland County.
Deer Lick Mineral Springs, Deerfield, Lake County.

Diamond Mineral Spring, Grantfork, Madison County.
Elmhurst Mammoth Spring, Elmhurst, Dupage County.
Glen Flora Mineral Springs, Waukegan, Lake County.
Gravel Springs, near Jacksonville, Morgan County.
Macinac Mineral Spring, near Carlock, Woodford County.
Magnesia Spring, Montgomery, Kane County.
Min-ni-Ni yan Spring, Bristol, Kendall County.
Mokena Mineral Spring, Mokena, Will County.
Original Springs, Okawville, Washington County.
Red Avon Mineral Spring, Avon, Fulton County.
Sanicula Springs, Ottawa, Lasalle County.
White Diamond, formerly Spouting Mineral Spring, South Elgin, Kane County.

INDIANA.

To the 1902 list for Indiana 7 springs have been added and 1 has been dropped. The total is 23 for 1903, of which the following 20 report sales:

Blue Cast Magnetic Springs, Woodburn, Allen County.
Cartersburg Magnetic Spring, Cartersburg, Hendricks County.
Coats Springs, Logan, Pike County.
Elliott Springs, Willow Valley, Martin County.
Emerald Spring, Mudlavia, Warren County.
French Lick Springs, French Lick, Orange County.
Greenwood Mineral Well, Greenwood, Johnson County.
Hunter Mineral Spring, Kramer, Warren County.
King's Mineral Spring, Muddyfork, near Dallas, Clark County.
Lasalle Springs, Martin County.
Laxine Spring, formerly McCarty's Spring, Mount Moriah, Brown County.
Lily White Sulphur Spring, Sulphur, Crawford County.
Lodi Artesian Well, Silverwood, Fountain County.
Mudlavia, formerly Indiana Mineral Springs, Mudlavia, Warren County.
Mudlavia Artesian Sulphur Spring, Mudlavia, Warren County.
Paoli Lithia Spring, Paoli, Orange County.
Indiana Carlsbad (formerly Porter) Mineral Springs, near Porter's Depot, Porter County.
Shelbyville Lithia Spring, Shelbyville, Shelby County.
Winamac Artesian Well, Winamac, Pulaski County.
Winona Grotto Lithia Spring, Winona Lake, Kosciusko County.

INDIAN TERRITORY.

The 1 spring credited to Indian Territory reports sales for 1903. It is:

Beach Spring, Sulphur, Chickasaw Nation.

IOWA.

Of the 6 springs credited to the list for Iowa, only 1 report sales for 1903. It is the following:

Ottumwa Mineral Springs, East Ottumwa, Wapello County.

KANSAS.

The Kansas list gains 1 spring, which makes a total of 17. Of these, 16 report sales for 1903, as follows:

Arrington Mineral Springs, Arrington, Atchison County.
Abilene Mineral Wells, Willowdale Township, Dickinson County.
Boon Mineral Spring, Topeka, Shawnee County.
California Spring, near Ottawa, Franklin County.
Geuda Mineral Springs, Geuda Springs, Cowley County.
Geyser Mineral Spring, Rosedale, Wyandotte County.
Hoover's Mineral Spring, Onaga, Pottawatomie County.
Jewell County Lithium Spring, Montrose, Jewell County.
Merrill Mineral Spring, Carbondale, Osage County.
Phillips's Mineral Spring, Topeka, Shawnee County.
Sand Springs, Abilene, Dickinson County.
Sulpho-Saline Spring, Fort Scott, Bourbon County.
Sun Springs, near Merrill, Brown County.
Sycamore Mineral Springs, Springs, Brown County.
Waconda Spring, near Cawker City, Mitchell County.
Iola Mineral Well, Iola, Allen County.

KENTUCKY.

The number of springs credited to Kentucky remains the same for 1903 as for 1902, 1 spring having been dropped and 1 added. The total is 6, and of these 5 report sales for 1903 as follows:

Anita Spring, Lagrange, Oldham County.
Bedford Springs, Bedford, Trimble County.
Bluelick Springs, Bluelick Springs, Nicholas County.
Crab Orchard Springs, Crab Orchard, Lincoln County.
Hamby Salts, Iron and Lithia Well, Dawson Springs, Hopkins County.

LOUISIANA.

There is no change in the list for Louisiana; reports have been received from the 3 springs credited to the State. They are as follows:

Abita Springs, Abita Springs, St. Tammany Parish.
Mandeville Springs, St. Tammany Parish.
Ozone Spring, Pearl River, St. Tammany Parish.

MAINE.

There is a net gain of 2 springs for Maine, 3 having been added to the list of 1902 and 1 dropped from it. Of the total of 28 for 1903, the following 24 report sales:

Bluehill Mineral and Dirigo Springs, Bluehill, Hancock County.
Carrabasset Spring, Jerusalem Township, Franklin County.
Cold Bowling Spring, Steep Falls, Limington, York County.
Crystal Mineral Springs, Auburn, Androscoggin County.
Forest Springs, Litchfield, Kennebec County.
Glenwood Mineral Spring, St. Albans, Somerset County.
Highland Spring, Lewiston, Androscoggin County.
Indian Hermit Spring, Wells Beach, York County.

Ishka Springs, Hancock, Hancock County.
Keystone Mineral Spring, East Poland, Androscoggin County.
Mount Hartford Cold Spring, Hartford, Oxford County.
Mount Zircon Spring, Rumford, Oxford County.
Oak Grove Spring, Brewer, Penobscot County.
Oxford Spring, Oxford, Oxford County.
Paradise Spring, Brunswick, Cumberland County.
Pine Spring, Topsham, Sagadahoc County.
Pownal Spring, West Pownal, Cumberland County.
Puritan Spring, Pine Point, York County.
Rocky Hill Spring, Fairfield, Somerset County.
Seal Rock Springs, Saco, York County.
Underwood Spring, Falmouth Foreside, Cumberland County.
Utona Spring, Eastport, Washington County.
Wawa Lithia Spring, Ogunquit, Wells, York County.
Wilson Spring, North Raymond, Cumberland County.

MARYLAND.

Maryland loses 2 springs from the list of 1902, which leaves a total of 9 for 1903. Of these all report sales. They are the following:

Blackiston Island Diuretic Mineral Spring, Blackiston Island, St. Mary County.
Bladensburg Spa, Bladensburg, Prince George County.
Carroll Springs, Forest Glen, Montgomery County.
Chattolanee Springs, Chattolanee, Baltimore County.
Elim or Willmead Spring, Oxon Hill, Prince George County.
Mardela Mineral Spring, Mardela, Wicomico County.
Rock Hill Indian Spring, Rockville, Montgomery County.
Roland Park Artesian Well, Roland Park, Baltimore County.
Takoma Spring, Takoma, Montgomery County.

MASSACHUSETTS.

Massachusetts loses 6 springs from the list of 1902. The total is 75 for 1903, of which 64 report sales as follows:

Abbotts Spring, Methune, Essex County.
Arctic Polar Spring, Spencer, Worcester County.
Ballardvale Lithia Spring, Andover, Essex County.
Beach Hill Spring, Stoneham, Middlesex County.
Beaver Dam Spring, Scituate, Plymouth County.
Belmont Crystal Spring, Belmont, Middlesex County.
Belmont Hill Spring, Everett, Middlesex County.
Belmont Natural Spring, Belmont, Middlesex County.
Berkshire Crystal Spring, Sheffield, Berkshire County.
Berkshire Sodium Spring, Sheffield, Berkshire County.
Bodwell Spring, Lawrence, Essex County.
Burnham Spring, Methuen, Essex County.
Calumet Spring, Sutton, Worcester County.
Chapman's Crystal Mineral Spring, Stoneham, Middlesex County.
Crystal Mineral Spring, Methuen, Essex County.
Crystal Spring, Brockton, Plymouth County.
Deep Rock Spring, Lynnfield Center, Suffolk County.
Diamond Spring, Lawrence, Essex County.
El-azhar (formerly Sheep Rock) Spring, Lowell, Middlesex County.

Everett Crystal Spring, Everett, Middlesex County.
Farrington's Silver Spring, Milton, Norfolk County.
Garfield Spring, Weymouth, Norfolk County.
Geddes Mineral Spring, Marlboro, Middlesex County.
Goulding Spring, Whitman, Plymouth County.
Highland Spring, North Abington, Plymouth County.
Howe Spring, Millbury, Worcester County.
Howland Spring, Dartmouth, Bristol County.
Hygeia Artesian Well, Springfield, Hampden County.
Katahdin Spring, Lexington, Middlesex County.
King Philip Crystal Spring, Mattapoisett, Plymouth County.
Läkoo Crystal Indian Spring, Lawrence, Essex County.
Leland Spring, Natick, Middlesex County.
Lovers' Leap Springs, Lynn, Essex County.
Magnolia Spring, Gloucester, Essex County.
Massasoit Spring, West Springfield, Hampden County.
Milton Spring, Milton, Norfolk County.
Monatiquot Spring, South Braintree, Norfolk County.
Moose Hill Spring, Swampscott, Essex County.
Mount Blue Spring, Hingham Center, Plymouth County.
Mount Holyoke Lithia Spring, South Hadley, Hampshire County.
Mount Washington Cold Spring, Chelsea, Suffolk County.
Myles Standish Spring, South Duxbury, Plymouth County.
Nashoba Mineral Spring, Westford, Middlesex County.
Nemashet Springs, Middleboro, Plymouth County.
Nobscot Mountain Spring, Framingham, Middlesex County.
Norwood Spring, Norwood, Norfolk County.
Pearl Hill Mineral Spring, Fitchburg, Worcester County.
Pepperell Mineral Spring, Pepperell, Middlesex County.
Pequot Spring, North Natick, Middlesex County.
Purity Spring, Spencer, Worcester County.
Ravenwood Spring, Gloucester, Essex County.
Robbin's Spring, Arlington Heights, Middlesex County.
Sager Spring, Danvers, Essex County.
Sand Spring, Williamstown, Berkshire County.
Shawmut Spring, West Quincy, Norfolk County.
Silver Seal Spring, Woburn, Middlesex County.
Simpson Spring, South Easton, Bristol County.
Smiley Spring, Haverhill, Essex County.
Sunnyside Spring, Franklin, Norfolk County.
Swampscott Spring, Swampscott, Essex County.
Trapelo Spring, Belmont, Middlesex County.
Undine Crystal Spring, Brighton, Suffolk County.
Valpey Spring, Woodland, Lawrence, Essex County.
Whitman Spring, Whitman, Plymouth County.

MICHIGAN.

There is a net loss of 1 spring for Michigan, 2 springs having been dropped from the list of 1902 and 1 added to it. This leaves the total for 1903 at 29, and of these 19 report sales as follows:

Alma-Bromo Spring, Alma, Gratiot County.
Andrews Magnetic Mineral Springs, St. Louis, Gratiot County.
Bromo-Hygeia Mineral Well, Coldwater, Branch County.

Clementine Spring, Mount Clemens, Macomb County.
Cooper Farm Spring, Birmingham, Oakland County.
Eastman Mineral Springs, Benton Harbor, Berrien County.
Magnetic Mineral Spring, Spring Lake, Ottawa County.
Midland Mineral Springs, Midland City, Midland County.
Mount Clemens Sprudel Water, Mount Clemens, Macomb County.
Original Mount Clemens Mineral Spring, Mount Clemens, Macomb County.
Pagoda Spring, Mount Clemens, Macomb County.
Plymouth Rock Well, Plymouth, Wayne County.
Ponce de Leon Springs, Paris Township, Kent County.
Prosit Flowing Well, Oak Grove, Flint, Genesee County.
Royal Oak Mineral Springs, Royal Oak, Oakland County.
Salutaris Spring, St. Clair Springs, St. Clair County.
Senator, formerly Americanus Well, Lansing, Ingham County.
Sanitas Spring, Topinabee, Cheboygan County.
Zauber Wasser Springs, Hudson, Lenawee County.

MINNESOTA.

The list for Minnesota for 1903 includes 5 springs, which is 1 less than for 1902, as 1 spring has been dropped. The total for 1903 is 5, and of these the following 4 report sales:

Indian Medical Spring, Elk River, Sherburne County.
Inglewood and Glenwood Springs, Minneapolis, Hennepin County.
Mankato Mineral Springs, near Mankato, Blue Earth County.
Trio Siloam Springs, Austin, Mower County.

MISSISSIPPI.

Mississippi gains 1 spring and the total for 1903 is 8. Of these the following 6 report sales:

Arundel Lithia Springs, near Meridian, Lauderdale County.
Browns Wells, Browns Wells, Copiah County.
Castalian Springs, near Durant, Holmes County.
Godbold Mineral Well, near Summit, Pike County.
Stafford Mineral Springs, near Vosburg, Jasper County.
Tallaha Springs, near Charleston, Tallahatchie County.

MISSOURI.

Missouri makes a net gain of 4 springs, 1 spring being dropped, and the total becoming 23 for 1903. Of these the following 19 report sales:

Akesion or Healing Spring, Sweet Springs, Saline County.
American Mineral Springs, St. Louis County.
Aqua Vitæ Gusher Spring, Canton, Lewis County.
B. B. Mineral Springs, Bowling Green, Pike County.
Blue Lick Springs, Blue Lick, Saline County.
Crystal Lithium Spring, Excelsior Springs, Clay County.
Cusenbury Spring, near Kansas City, Jackson County.
Eldorado Springs, Eldorado Springs, Cedar County.
Haymakers Lineville Springs, Mercer County, near Lineville, Iowa.

Ionian Lithia Spring, near Bowling Green, Pike County.
Jackson Lithia Springs, Jackson County.
Kalekat Bitter Spring, near Bowling Green, Pike County.
Lineville Mineral Springs, Mercer County, near Lineville, Iowa.
Livertone Spring, near Bowling Green, Pike County.
McAllister Springs, McAllister, Saline County.
Monegaw Springs, Monegaw Springs, St. Clair County.
Montesano Springs, Jefferson County.
Sweet Springs, Sweet Springs, Saline County.
Windsor Spring, Windsor, St. Louis County.

MONTANA.

Of the 3 springs credited to Montana the 2 following report sales for 1903:

Lissner's Mineral Springs, Helena, Lewis and Clarke County.
White Sulphur Springs, White Sulphur Springs, Meagher County.

NEBRASKA.

No report of sales for 1903 has been received from the 1 spring credited to Nebraska.

NEVADA.

No report of sales for 1903 has been received from the 1 spring on the list for Nevada.

NEW HAMPSHIRE.

New Hampshire loses 3 springs from the list of 1902. The total is 6 for 1903; of these the following 5 report sales:

Amherst Mineral Spring, Amherst, Hillsboro County.
Granite State Spring, Plaistow, Rockingham County.
Lafayette Spring, West Derry, Rockingham County.
Londonderry Lithia Spring, Londonderry, Rockingham County.
Pack Monadnock Lithia Spring, Temple, Hillsboro County.

NEW JERSEY.

New Jersey loses 2 springs from the list of 1902. The total is 14 for 1903, and sales are reported by 12, as follows:

Alpha Spring, Springfield, Union County.
Beacon Mountain Spring, Denville, Morris County.
Beech Springs, near Woodbury, Gloucester County.
Fowler's Deep Rock Artesian Well, Allwood, Passaic County.
Hatawanna Spring, Buddlake, Morris County.
Indian Kalium Spring, Gloucester, Camden County.
Indian Spring, near Rockaway, Morris County.
Kalium Springs, Collingswood, Camden County.

Oakland Vernam Spring, near Oakland, Bergen County.
Turtle Hill Spring, Passaic, Passaic County.
Washington Rock Spring, Warrenville, Somerset County.
Watchung Spring, Plainfield, Union County.

NEW MEXICO.

There is no change in the list for New Mexico. Of the 7 springs credited to the State 6 report, as follows:

Artesian Coyote Mineral Spring, Coyote Canyon, Bernalillo County.
Coyote Canyon Spring, Coyote Canyon, Bernalillo County.
Faywood (formerly Hudson) Hot Springs, Faywood, Grant County.
Harsch Iron Spring, Coyote Canyon, Bernalillo County.
Macbeth Springs, near East Las Vegas, San Miguel County.
Ojo Caliente Spring, Ojo Caliente, Taos County.

NEW YORK.

For the State of New York 1 spring is added to the list of 1902 and 3 taken from it. The total for 1903 is 62. Of these 48 report, as follows:

Ayers Amherst Mineral Springs, near Williamsville, Erie County.
Baldwin Cayuga Mineral Spring, Cayuga, Cayuga County.
Big Indian Spring, Ellenville, Ulster County.
Chemung Spring, Chemung, Chemung County.
Clyde Mineral Spring, Clyde, Wayne County.
Deep Rock Spring, Oswego, Oswego County.
Dryden Springs, Dryden, Tompkins County.
Elixir Spring, Clintondale, Ulster County.
Fitzsimmons Spring, Port Jervis, Orange County.
Franklin Lithia Springs, Franklin Springs, Oneida County.
Geneva Lithia Mineral Water Spring, Geneva, Ontario County.
Glacier Spring, Franklin Springs, Oneida County.
Great Bear Spring, near Fulton, Oswego County.
Hide Franklin Spring, Ballston Spa, Saratoga County.
Kirkland Mineral Spring, Franklin Iron Works, Oneida County.
Lithia Polaris Spring, near Boonville, Oneida County.
Mountain Mist Spring, West Hills, Suffolk County.
Mount View Spring, near Poughkeepsie, Dutchess County.
Red Jacket Mineral Spring, Seneca Falls, Seneca County.
Saratoga County Artesian Lithia Spring, Ballston Spa, Saratoga County.
Saratoga Springs, Saratoga County:
  Champion Spring.
  Chief (formerly Re-me-ho) Spring.
  Congress Spring.
  Empire Spring.
  Eureka White Sulphur and Mineral Spring.
  Excelsior Spring.
  Geyser Spring.
  Hathorn Spring.
  High Rock Spring.
  Lincoln Spring.

Saratoga Springs, Saratoga County—Continued.
- Old Putnam Mineral Spring.
- Patterson Mineral Spring.
- Peerless Spring.
- Quevic Spring.
- Saratoga Arondack (formerly Kissingen) Spring.
- Saratoga Carlsbad Spring.
- Saratoga Seltzer Spring.
- Saratoga Star Spring.
- Saratoga Vichy Spring.
- Saratoga Victoria Spring.
- Union Spring.

Split Rock Spring, Franklin Springs, Oneida County.
The Vita Spring, Fort Edward, Washington County.
Verona Mineral Springs, Verona, Oneida County.
Warner's Natural Mineral Spring, Franklin Springs, Oneida County.
Washington Lithia Spring, Ballston Spa, Saratoga County.
White Sulphur Springs, Richfield Springs, Otsego County.
White Sulphur Spring, Sharon Springs, Schoharie County.

NORTH CAROLINA.

There is no change in the list for North Carolina, the total for 1903 remaining at 12. Of these 9 report sales, as follows:

Alkalithia Spring, Alkalithia Springs, Alexander County.
Ashley Bromine and Arsenic Springs, Ashe County.
Barium Rock Spring, Barium Springs, Iredell County.
Jackson Springs, Jackson Springs, Moore County.
Lemon Springs, Lemon Springs Station, Moore County.
Mida Spring, near Charlotte, Mecklenburg County.
Panacea Springs, near Littleton, Warren County.
Thompson Bromine Arsenic Springs, Crumpler, Ashe County.
Vade Mecum Spring, Vade Mecum, Stokes County.

OHIO.

Ohio's list for 1903 shows no change from 1902, the total remaining at 22. Of these 18 report sales. They are the following:

Adevene Spring, Delaware, Delaware County.
Alba Spring, Rockfort, Cuyahoga County.
Arcadian Springs, Mineral Springs, Adams County.
Buckeye Lithia Spring, near Martins Ferry, Belmont County.
Crum Mineral Spring, Austintown, Mahoning County.
Crystal Rock Spring, near Sandusky, Erie County.
Deerfield Mineral Springs, Deerfield, Portage County.
Fargo Mineral Springs, Ashtabula, Ashtabula County.
Green Spring Artesian Mineral Well, Green Springs, Sandusky County.
Knisely Mineral Springs, Bucyrus, Crawford County.
Magnetic Magnesia Well, Canton, Stark County.
Oakridge Spring, Greensprings, Sandusky County.
Painesville Mineral Spring, Painesville, Lake County.
Rex Ferro-Lithia Springs, New Richmond, Clermont County.

Ripley Brom-Lithia Springs, Ripley, Brown County.
Talewanda Mineral Springs, near College Corner, Preble County.
Wheeler Mineral Springs, Youngstown, Mahoning County.
Sulphur Lick Spring, Chillicothe, Ross County.

OKLAHOMA.

No report has been received from the 1 spring credited to Oklahoma.

OREGON.

Oregon gains 1 spring, which makes the total 9. Of these the following 8 report sales for 1903:

Boswell Springs, Boswell, Douglas County.
Colestin Spring, Colestin, Jackson County.
Kingsbury Spring, near Ashland, Jackson County.
Lehman Spring, Blue Mountains, Umatilla County.
Sodaville Mineral Springs, Sodaville, Linn County.
Wilhoit Springs, Wilhoit, Clackamas County.
Wolfer's Mineral Spring, Hubbard, Marion County.
Lake View Hot Springs, near Lake View, Lake County.

PENNSYLVANIA.

There is a net gain of 1 in the list for Pennsylvania, the total being 38. Of these 29 report sales for 1903. They are the following:

Bedford Chalybeate Spring, Bedford, Bedford County.
Bedford Mineral Springs, near Bedford, Bedford County.
Black Barren Mineral Spring, Pleasant Grove, Lancaster County.
Charmian Mineral Spring, Charmian, Franklin County.
Corry Artesian Mineral Spring, Corry, Erie County.
Cresson Springs, Cresson, Cambria County.
De Vita Mineral Springs, Cambridge Springs, Crawford County.
East Mountain Lithia Well, near Factoryville, Wyoming County.
Ephrata Mountain Crystal Spring, near Ephrata, Lancaster County.
Glen Summit Spring, Glen Summit, Luzerne County.
Granny Coon Spring, North Point, Indiana County.
Gray Mineral Spring, Cambridge Springs, Crawford County.
Imperial Spring, Angelica, Berks County.
Korrylutz Well, Corry, Erie County.
Magnesia Spring, Cambridge Springs, Crawford County.
Minequa Spring, Minnequa, Bradford County.
Pavilion Spring, South Mountain, Wernersville, Berks County.
Petticord Mineral Spring, Cambridge Springs, Crawford County.
Ponce de Leon Spring, Meadville, Crawford County.
Pulaski Natural Mineral Spring, Pulaski, Lawrence County.
Rennyson Tredyffrin Spring, Rennyson, Chester County.
Ross-common Springs, Windgap, Monroe County.
Saegertown Mineral Spring, Saegertown, Crawford County.
Sizer Mineral Spring, Sizerville, Cameron County.
Spruce Hollow Mineral Spring, near Northumberland, Northumberland County.
The J. W. Lang Mineral Well, Venango, Crawford County.
Tuckahoe Mineral Springs, Northumberland, Northumberland County.
Whann Alkaline Lithia Mineral Springs, near Franklin, Venango County.
White Sulphur Spring, Bedford Springs, Bedford County.

RHODE ISLAND.

The list for Rhode Island remains the same as for 1902, the total being 4. Of these 3 report sales. They are as follows:

Gladstone Spring, Narragansett Pier, Washington County.
Holly Mineral Spring, Woonsocket, Providence County.
Ochee Mineral and Medicinal Springs, Johnston, Providence County.

SOUTH CAROLINA.

South Carolina gains 1 spring, but of the 10 springs now credited to the State, only 3 report sales for 1903. They are the following:

Cherokee Springs, near Spartanburg, Spartanburg County.
Glowing Spring, near Calhoun Falls, Abbeville County.
Harris Lithia Spring, Harris Springs, Laurens County.

SOUTH DAKOTA.

The two localities credited to South Dakota report for 1903. They are:

Hot Springs of South Dakota, Hot Springs, Fall River County:
- Catholicon Spring.
- Hygeia Spring.
- Kidney Spring.
- Lakotah Spring.
- Minnekahta Spring.

Minnehaha Springs, Sioux Falls, Minnehaha County.

TENNESSEE.

Tennessee gains 1 spring, which brings the total up to 14. Of these, 13 report sales for 1903. They are the following:

Eastbrook Springs, Eastbrook, Franklin County.
Hinson Springs, Hinson Springs, Henderson County.
Horn Mineral Springs, Horn Springs, Wilson County.
Idaho Springs, near Clarksville, Montgomery County.
Lockeland Spring, East Nashville, Davidson County.
Montvale Spring, Montvale, Blount County.
Red Boiling Springs, Red Boiling Springs, Macon County.
Rhea Springs, Rhea Springs, Rhea County.
Tate Epsom Spring, Tate Spring, Grainger County.
Tillman Spring, near Nashville, Davidson County.
Whittle Springs, Whittle Springs, near Knoxville, Knox County.
Willow Brook Spring, Craggie Hope, Cheatham County.
Wright's Epsom Lithia Well, Mooresburg, Hawkins County.

TEXAS.

The 1902 list for Texas has 2 springs added to it and 1 dropped from it, the total being 28 for 1903. Of these, 21 report sales, as follows:

Capp's Wells, Longview, Gregg County.
China Spring Well, China Springs, McLennan County.
Dalby Spring, Dalby Springs, Bowie County.
Dullnig Mineral Wells, near San Antonio, Bexar County.
Elkhart Mineral Wells, Elkhart, Anderson County.
Farrier Springs, Dalby Springs, Bowie County.
Georgetown Mineral Well, Georgetown, Williamson County.
Marlin Hot Well, Marlin, Falls County.
Milford Mineral Well, Milford, Ellis County.
Mineral Wells, Palo Pinto County:
- Cicero Smith Well.
- Crazy Well.
- George P. Barber Wells.
- Gibson Well.
- Hawthorne Well.
- Lithia Well.
- Sangcura Wells.
- Specific Wells.
- Star Well.

Overall Mineral Wells, Franklin, Robertson County.
Peterman Mineral Spring, Mount Pleasant, Titus County.
Wootan Wells, Wootan Wells, Robertson County.

UTAH.

Of the 3 springs credited to Utah only 1 reports for 1903. It is the following:

Deseret Lithia Well, Deseret, Millard County.

VERMONT.

Vermont gains 1 spring, the total being 7. Of these 5 report sales for 1903. They are the following:

Alburg Chalybeate, Lithia, and Sulphur Springs, Alburg Spring, Grand Isle County.
Clarendon Springs, Clarendon Springs, Rutland County.
Equinox Spring, Manchester, Bennington County.
Missisquoi Mineral Springs, Sheldon, Franklin County.
Newfane or Vermont Mineral Spring, Putney, Windham County.

VIRGINIA.

Virginia gains 2 springs, 3 having been added to the list and 1 dropped from it. Of the 58 springs credited to the State, 41 report sales for 1903. They are the following:

Alleghany Springs, Montgomery County.
Basic Lithia Spring, Basic City, Augusta County.
Bear Lithia Springs, near Elkton, Rockingham County.

Bedford Alum Spring, Bedford Springs, Campbell County.
Beaufont Lithia Spring, Beaufont, Chesterfield County.
Bellfont Spring, near Manchester, Chesterfield County.
Berry Hill Mineral Spring, near Elkwood, Culpeper County.
Blue Ridge Springs, Botetourt County.
Buffalo Lithia Springs, Buffalo Lithia Springs, Mecklenburg County.
Chase City Mineral Springs, Chase City, Mecklenburg County.
Cove Lithia Spring, Wytheville, Wythe County.
Crockett Arsenic Lithia Spring, Shawsville, Montgomery County.
Diamond Spring, Norfolk County.
Erup Mineral Spring, near Glen Carlyn, Alexandria County.
Farmville Lithia Springs, Cumberland County, near Farmville, Prince Edward County.
Fonticello Lithia Spring, Chesterfield County, near Richmond.
Golindo Lithia Springs, Weyers Cave, Augusta County.
Harris Anti-Dyspeptic and Tonic Spring, Burkeville, Nottoway County.
Healing Springs, Healing Springs, Bath County.
Hume Springs, St. Elmo, Alexandria County.
Hunter's Pulaski Alum Springs, Walkers Creek, Pulaski County.
Jeffress Lithia Silica Springs, Jeffress, Mecklenburg County.
Lone Jack Spring, Candless Mountain, Campbell County.
Magee's Chlorinated Lithia Springs, Clarksville, Mecklenburg County.
Massanetta Springs, Harrisonburg, Rockingham County.
Montvale Hygeia Spring, Montvale, Bedford County.
Nye Lithia Springs, Wytheville, Wythe County.
O'Connell Lithia Spring, near Stribling Springs, Augusta County.
Osceola Spring, Pleasant Valley, Rockingham County.
Otterburn Lithia and Magnesia Springs, Amelia, Amelia County.
Pontiac (formerly Powhatan) Spring, near Falls Church, Alexandria County.
Roanoke Red Sulphur Springs, Catawba, Roanoke County.
Seawright Magnesian Lithia Spring, near Staunton, Augusta County.
Seven Springs, near Glade Spring, Washington County.
Shenandoah Alum Springs, near North Mountain, Shenandoah County.
Stribling Springs, near Staunton, Augusta County.
Virginia Magnesian Alkaline Springs, near Staunton, Augusta County.
Virginia Waukesha Lithia Springs, Staunton, Augusta County.
Wallawhatoola Alum Springs, near Millboro Spring, Bath County.
Wolf Trap Lithia Springs, Wolf Trap Depot, Halifax County.
Wyrick's Lithia Spring, near Crockett, Wythe County.

WASHINGTON.

The 1903 list for Washington remains the same as in 1902, the total being 4, of which 3 report sales as follows:

Cascade Springs, near Cascades, Skamania County.
Medical Lake, Medical Lake, Spokane County.
Olympia Hygeian Spring, Tumwater, Thurston County.

WEST VIRGINIA.

To the 1902 list for West Virginia, 2 springs are added. The total is 11 for 1903. Of these the following 6 report sales:

Borland Mineral Well, Wood County, near Salama.
Greenbrier (formerly Barger's) Springs, near Talcott, Summers County.

Magnesia Spring, No. 2, near Wheeling, Ohio County.
Manacea Irondale Spring, near Independence, Preston County.
Pence Spring, Pence Springs, Summers County.
Webster Springs, Webster Springs, Webster County.

WISCONSIN.

To the 1902 list for Wisconsin 1 spring is added and 2 are taken from it. Of the 37 springs credited to the State 26 report sales for 1903. They are the following:

Allouez Magnesia Springs, Green Bay, Brown County.
Bay City Spring, Ashland, Ashland County.
Chippewa Spring, Chippewa Falls, Chippewa County.
Darlington Mineral Spring, Darlington, Lafayette County.
Fort Crawford Springs, Prairie du Chien, Crawford County.
Lebens Wasser Mineral Spring, Green Bay, Brown County.
Nee-Ska-Ra Mineral Spring, Wauwatosa, Milwaukee County.
New Saratoga Spring, Star Prairie, St. Croix County.
Rainbow Mineral Spring, Wautoma, Waushara County.
Salvator Mineral Spring, Green Bay, Brown County.
Sanitas Fountain, Oshkosh, Winnebago County.
Sheboygan Mineral Spring, Sheboygan, Sheboygan County.
Silver Sand Spring, Milwaukee, Milwaukee County.
Solon Springs, Upper St. Croix Lake, Douglas County.
Waukesha Springs, Waukesha County:
- Acme Spring.
- Almanaris Springs.
- Anderson's Waukesha Spring.
- Arcadian Spring.
- Glen Rock Spring.
- Hygeia Spring No. 2.
- Minniska Mineral Spring.
- Siloam Mineral Spring.
- Silurian Mineral Spring.
- Sotarian Spring.
- Waukesha Imperial Spring.
- White Rock Mineral Spring.

WYOMING.

Wyoming gains 1 spring, and of the 2 credited to the State only 1 reports sales for 1903. It is the following:

Rawlins Sulphur Springs, near Rawlins, Carbon County.

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, 1867–1903.

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	438,212	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	7,183	2,322,008	433,281
1891	26,700	8,700	2,019,833	392,894
1892	16,052	9,069	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
1903	....	....	a 2,851,970	a 846,294

a Including artificial.

Prior to the year 1873, as the foregoing tables show, the records of the United States Treasury Department did not distinguish natural and artificial mineral waters. From 1873 to 1883, inclusive, the distinction was made, and artificial mineral waters were classified according to the receptacles in which they were imported. For the period including the years 1884 to 1896 this classification seems to have been dropped, but the artificial waters were still kept separate from the natural waters. Since 1896, however, they have not been differentiated. The number of gallons imported has not varied greatly in the last six years, although each year the imports have increased slightly both in quantity and in value.

EXPORTS.

No record of the exports of domestic natural mineral waters seems to have been kept by the Treasury Department since 1883, and, as shown by the table below, the exports from 1875 to 1883 were comparatively insignificant.

Exports of natural mineral waters of domestic production from the United States.

Fiscal year ending June 30—	Value.	Fiscal year ending June 30—	Value.
1875	$162	1881	$1,0[illegible]
1876	80	1882	[illegible]
1879	1,529	1883	[a] [illegible]
1880	1,486		

[a] None reported since 1883.

MONAZITE AND ZIRCON.

By Joseph Hyde Pratt.

INTRODUCTION.

Monazite and zircon are mined for similar purposes—that is, for the rare earth oxides which they contain. The oxides obtained from these minerals are used in the manufacture of mantles for various incandescent lamps and of the glowers of electric lamps. The production of zircon is very small, and represents but a small percentage of the total production of these two minerals. The demand for monazite is increasing, although there is not a very large increase in the yearly production. Formerly all of this mineral produced was consumed in this country; now a considerable portion of that mined is exported. Of the zircon mined, however, all is used in the United States.

MONAZITE.

Monazite, which is essentially an anhydrous phosphate of the rare earth metals, cerium, lanthanum, and didymium, usually contains a small but varying percentage of thoria. It is the presence of this latter oxide that gives the monazite its commercial value. There is a very wide variation in the percentage of thoria found in monazite, but the commercial monazite that is put on the market contains from 3 to 9 per cent of this oxide. The thoria, together with very small amounts of lanthanum and didymium oxides, is used in the manufacture of the cylindrical hood or mantle of the Welsbach and other incandescent gas lights. The cerium oxalate, obtained in the separation of the ceria from the other oxides, is used to a limited extent in pharmacy.

Monazite varies considerably in color, being light yellow to honey yellow, reddish, brownish, and yellowish green, and having resinous to vitreous luster. It is brittle, breaking with a conchoidal to uneven fracture; and is from 5 to 5.5 in hardness. The mineral is heavy, having a specific gravity of 4.64 to 5.3. By means of its color and specific gravity it can usually be readily identified.

LOCALITIES.[a]

The commercial deposits of monazite 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 that contained the monazite. These rocks have been altered and decomposed to a considerable depth, so that at the present time they are in a state of constant erosion; and their mineral constituents, monazite, zircon, magnetite, etc., are being deposited in the soils and gravels. This is going on to such an extent that even after the soils and gravels have been once worked for monazite they may be rewashed at the end of a year and may prove to be profitable sources of monazite.

NORTH CAROLINA.

The supply of monazite is obtained from Cherokee and Spartanburg counties, S. C., and from Rutherford, McDowell, Burke, Cleveland, and Lincoln counties, N. C. There are in most of these counties a large number of small miners who produce from a few pounds to a ton of monazite per year. Many of them do not concentrate their product except as it is effected by the sluice boxes, and they sell their material to one of the four companies that are buying monazite either for their own use or for exportation. These concentrates vary considerably in color, according to the locality from which they have been obtained, and there are consequently monazite concentrates red, red-brown, brown, yellowish brown, yellowish green, and yellow in color.

Rutherford County.—One of the centers of the monazite mining industry in North Carolina is Ellenboro, Rutherford County. Near this place is located the property of the German Monazite Company, which employs 26 or more men who wash out about 1½ tons of cleaned sand each week. Their workable gravel is from 20 to 100 yards wide and extends for half a mile up and down the creek. The overburden, which has to be removed, is from 1 to 5 feet in depth, and some of it carries a small amount of monazite.

Three miles from Ellenboro at the Louisa Smart mine, three different colored monazite sands are found which are not more than 100 yards apart, one being of a greenish color, the second brownish red, and the third yellowish. The first is found along the small branch just above the drying plant, and the second is found higher up on the hillside about 60 feet from the stream. These two gravels are at present sluiced on but a small scale. They pan well, are quite free from garnet, and contain but little black sand. They are 3 feet thick, and are covered by from 2 to 3 feet of an overburden of red clay. The third or yellowish monazite sands are now being washed, but they

[a] The writer was assisted in the field work by Mr. D. B. Sterrett, of Yale University.

contain some garnet and iron. The brownish sand readily concentrates to a product containing 80 per cent monazite. This property would be more extensively worked but for the lack of a sufficient water supply. Near these gravel deposits there is a pegmatitic dike, 4 feet in width, which cuts the hornblende gneiss. This dike contains a great many garnets up to the size of a walnut and also monazite, as was proved by panning the crushed rock.

There are several other places near Ellenboro where monazite is mined. One is on the property of Mr. E. A. Martin, where a good percentage of monazite is obtained in panning the stream gravel and also the gravel for some distance under the banks, but the total area of the pay gravel is not large. Another is on the west fork of Sandy Run Creek on the land of Mr. J. C. Glover, where there is a considerable quantity of gravel, but it did not show a very large percentage of monazite on panning. The gravels are from 2 to 3 feet in thickness under an overburden of from 1 to 2 feet. There is, however, a good water supply, which is favorable for working the gravels in quantity. Only two sluice boxes were in operation during the past year on this property. Again, on a small tributary of Sandy Run Creek, on the land of Mr. J. D. Bridges, the stream gravel and the gravel and soil on the banks are exceedingly rich in monazite, but the area of the gravels is not very extensive. Three miles southeast of Ellenboro, also, on a small branch running through the plantation of Mr. D. B. Farrill, there are gravels which have been pretty well worked out once and are now being worked over the second time, yielding fairly good results. Only one sluice box, however, was in operation during 1903, although there was a sufficient water supply for others.

Rutherfordton is another center of monazite mining, and on the land of Mr. A. D. K. Wallace, 2 miles from Rutherfordton, considerable work has been carried on. The gravels in the bottom land are often 100 feet across and from 1 to 3 feet thick. The overburden, which is not very heavy, contains some monazite and is washed as well as the gravels. There are two small streams on this property, upon which workable gravel deposits, varying from 50 to 150 feet in width, extend for about a quarter of a mile. The water supply is good. About half a mile west of the Wallace deposits, on the land of Mr. H. Harris, there are also gravels that have already been washed and that extend up and down stream for a distance of nearly a mile. At Peppertown Creek, in the same neighborhood, where some mining has been done, the concentrates are low in monazite, being made up largely of black magnetic sand.

At Duncan, 17 miles from Ellenboro, on the land controlled by Mr. Henry Gettys, there are 30 acres of bottom land along about a mile of the stream which contain considerable monazite. The stream gravels are to be washed first, and then the bottom land. Six or eight troughs will probably be used. In the same vicinity, on the land of Mr. S. A. Mode, the stream gravels and the bottom-land gravels contain considerable monazite.

Cleveland County.—On the land of Mr. A. M. Hunt, 6 miles from Casar, Cleveland County, there were two sluice boxes in operation in 1903, although the gravel deposits would warrant more and although there was an abundant water supply with which to develop them. The gravels panned very well, showing a good percentage of monazite. They vary in thickness from 2 to 3 feet, and there is a good width of bottom land that has been only partially worked out. Near the upper end of this land the stream gravels are profitable for working over a number of times, as there has been no work done on the adjoining property and the rains are constantly bringing down new sources of supply of monazite.

In the vicinity of Carpenters Knob there are some very promising monazite gravel deposits, a number of which are now worked by the Incandescent Light and Chemical Company of New York. On the land of Mr. J. C. Crow, the bottom-land gravels are from 30 to 75 yards wide and average about 2 feet in thickness. During 1903 there were two sluice boxes at work on these gravels and two on the land of Mrs. Eliza Spakes farther up the stream. These lands are on the headwaters of Little Knob Creek. Farther down the creek, on the McSneed property, the monazite gravel was observed in one place to be 7 feet thick. Two sluice boxes were in operation on this property, but there is a sufficient supply of water for a larger number, which would be warranted by the quantity of gravel. Little Knob Creek has been worked, more or less, from near its source to its mouth; but in many places the gravels have received new supplies of monazite, so that it will pay to wash them again. On the property owned by the Incandescent Light and Chemical Company, five sluice boxes were in operation in 1903, and the stream gravel will be worked for about a mile. In a number of instances bottom gravels that had formerly been washed are now being washed again and at a profit. The gravel in some places is 5 feet in thickness. This company also owns and is working monazite gravels on Camp Creek in Burke County, and the Lattimore mine near Shelby, Cleveland County. They expect to erect a concentrating or cleaning mill near Carpenters Knob. Another good deposit of stream gravel and bottom-land gravel is on the land of Mr. W. E. Ledford, also near Carpenters Knob. These gravels pan very well, and there is a good water supply.

On Knob Creek there are very extensive stream gravels and considerable bottom-land gravels, which, although they do not contain a very large percentage of monazite, are extensive in area and have a good water supply, so that they could be worked on a large scale, and therefore could be mined profitably.

Near Mooresboro there are a number of small producers of monazite. The most work is done on the land of Mr. H. C. Burrus, who operated three sluice boxes or troughs in 1903. There is a considerable area of bottom lands, but only small portions of them are at present washed for monazite. The branch flowing through this property has been worked for a distance of about a mile, and has upon it workable deposits of 100 yards in width. The concentrates, however, contain a rather large percentage of the black sand.

Burke County.—In Burke County, on Brindletown Creek and its tributaries, there are many properties containing good deposits of monazite gravels, such as those of Messrs. J. E. Mills, John Kirksey, and Moore Epley.

McDowell County.—In McDowell County there are numerous good deposits on the waters of Muddy Creek, but an act of the legislature prohibits the use of these streams for sluicing purposes, and thus prevents the mining of monazite on the adjacent properties.

SOUTH CAROLINA.

In South Carolina the principal localities where monazite mining is carried on are in the vicinity of Cowpens, Spartanburg County, and near Gaffney, Cherokee County.

There is a tendency among a large number of the farmers who own lands containing monazite gravels to work only the stream gravels, and this they do two or three times a year, leaving the bottom land untouched except for farming. The heavy rains wash into the streams the sands from the hillsides, from under the banks, and from the streams above, thus renewing the monazite in the stream gravel. The surface soil down to from 6 to 8 inches of its depth seems to contain a considerable per cent of monazite which has come from the decomposition and disintegration of the adjacent rocks.

The monazite-bearing sand obtained from the sluice boxes is sometimes rewashed by the miners; but usually it is sold directly to some one of the companies owning the concentrating plants. The weighed concentrates are dried in two different ways. One way consists in spreading the sand over an oiled or rubber cloth in the sunshine, where it dries very quickly, partly because of the heat absorbed by the dark iron sand. The other method of drying is by heating over a crude furnace. A small ditch from 4 to 8 feet long, 1 to 1½ feet wide, and about 1 foot deep is dug. Over this a sheet-iron cover is placed, and a small chimney is built at one end. On this sheet-iron drying plate, under which there is a hot fire, the monazite is spread.

The concentrating mills now in operation in the monazite district are those of the Carolina Monazite Company, at Shelby, Cleveland County, N. C., and at Gaffney, Cherokee County, S. C.; that of the German Monazite Company, at Oakspring, Rutherford County, N. C.;

and that of the Incandescent Light and Chemical Company, near Carpenters Knob, Cleveland County, N. C.

Further cleaning of the concentrates from the sluice boxes of the miners has been perfected to such an extent that now a cleaned monazite sand can be obtained that is from 95 to 99 per cent monazite. This has been effected by means of the Wetherill electro-magnetic separator. The dried concentrates are placed in a hopper and from there fed to a classifier. The finer material, which contains the monazite, is allowed to pour over a revolving drum, and is thus scattered evenly over an 18-inch belt. This passes along under four powerful electro-magnets, which have small belts to carry the material attracted by the magnets out of the magnetic field. As soon as this point is reached the belts drop the sand, which passes through a chute to the proper receptacle placed to receive it. The first magnet removes all the magnetic iron, the larger pieces of garnet, and generally all of the titanic iron or ilmenite. If any of the latter passes this belt, it is removed, with all of the finer garnet sand, by the second magnet. The third magnet is so adjusted as to remove only the coarse monazite, and the fourth removes all of the finer pieces of monazite. The remaining sand—quartz, zircon, rutile, etc.—is dropped off the end of the large belt and is run into the waste pile.

The garnet, which is of very good quality, having a hardness of 7.5, will, if it is obtained in some quantity, be of value for abrasive purposes. There is some gold contained in these tailings, but no attempt is made to save it.

In washing some of the monazite gravels the gold which they contain is saved, and in many instances it has amounted to $1 or more per sluice box per day.

ZIRCON.

The mineral zircon is a silicate of zirconium ($ZrSiO_4$), and is commonly found in square tetragonal prisms terminated by the pyramid. It is usually of a grayish, light brown to reddish-brown color; occasionally it is found colorless to red and perfectly transparent, when it becomes of value as gem material. In hardness it is 7.5, and it has a specific gravity of 4.65. Besides the use that is made of the transparent varieties of this mineral for gems, there is a certain amount that is mined for its zirconia content. This oxide is used together with yttria in the manufacture of the glower for the Nernst electric lamp.

OCCURRENCE AND LOCALITIES.

Zircon is commonly found sparingly in the crystalline rocks, especially gneisses, syenites, and granites, in granular limestone, and in chloritic and other schists. Occasionally it is found associated with some of the iron ores. Occurrences of this mineral in quantity are not common, and there is but one locality in the United States where it has thus far been found in commercial quantity, and that is in the vicinity of Zirconia, Henderson County, N. C. The zircons occur in a pegmatitic dike, which is about 100 feet wide and has a strike of N. 50° E. It cuts up through the old Archean gneisses, and can be traced for a distance of about one and one-half miles. The upper portions of the pegmatitic dike are badly decomposed and kaolinized to a depth of 40 feet or more. The zircons occurring in this decomposed dike are well crystallized, and are usually prismatic crystals, grayish in color, and terminated by the unit pyramid. They occur for the most part in the feldspar, and where this is kaolinized it permits of an easy separation of the zircon crystals by hydraulic processes. As the feldspar becomes more solid and unaltered, the separation of the zircon is more difficult. When the feldspar is crushed, however, the zircons readily free themselves from the gangue. There are two deposits of these zircon crystals that have been worked—one near the southwestern end of the dike, known as the Freeman mine, and the other near the northeast end, known as the Jones mine. Owing to the slight demand for this mineral, there is no systematic mining carried on. Men and children are paid a certain price per pound for the zircon crystals, some of which they wash out of the soil, others out of the kaolinized gangue, and still others they break out by hand from the harder feldspar. The resulting product contains practically 100 per cent of zircon.

Near New Sterling, Iredell County, N. C., a great many brownish, pyramidal crystals of zircon have been found in the soil, some of which were from 1 to 3 inches in diameter. One crystal weighed about 6 ounces. The exact occurrence of these crystals has not as yet been definitely determined, but thus far there has been observed no indication of them in commercial quantity.

Small quantities of zircon are found in all the monazite sands and could probably be saved as a by-product. These crystals are very minute and are transparent.

PRODUCTION.

The total production of monazite in 1903 was 862,000 pounds, valued at $64,630, which is an increase of 60,000 pounds in quantity and of $470 in value, as compared with the production of 802,000 pounds, valued at $64,160, in 1902. This quantity represents the purified sand, containing from 85 to 99 per cent monazite. This was obtained from about 1,900,000 pounds of crude sand as taken from the sluice boxes, which is the material that goes through the magnetic separators. The price received for this crude sand by the individual miner varied from 2½ to 6 cents per pound, according to the percentage of thoria that it contained. By far the larger amount of this production of monazite was from North Carolina, Cleveland County leading in the quantity and value of its production.

The quantity of zircon obtained in 1903 was 3,000 pounds, valued at $570. This makes the total production of these minerals mined for use in the manufacture of various lamps amount to 865,000 pounds in quantity, valued at $65,200. In the following table there is given the production and value of monazite mined in the United States from 1893 to 1903:

Production of monazite in the United States, 1893–1903.

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
1903	862,000	64,680

IMPORTS AND EXPORTS.

There are small amounts of monazite sand imported into the United States from year to year, but they are of no importance in comparison with the home production. In 1903 there were no imports of monazite sand and thorite; in 1902 the imports amounted 190 pounds, valued at $12.

The imports of nitrate of thorium in 1903 amounted to 64,520 pounds, valued at $232,155, as compared with 42,815 pounds, valued at $131,350, imported in 1902.

No exports of monazite sand are reported for the year 1903.

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 in sufficient purity to be used in the manufacture of glass.

As the report for 1902 contained a full description of glass sand, no attempt is made in this report to give anything but the statistics of production for 1903.

The following tables show the quantity and the value of glass sand and other sand produced in the United States in 1902 and 1903.

From the table for 1903 it will be seen that California and Georgia have been added to the list of glass-sand producing States. The quantity and value of glass sand mined in 1903 was 823,044 short tons, valued at $855,828, as compared with 943,135 short tons, valued at $807,797, in 1902, a decrease in quantity mined of 120,091 tons and an increase in value of $48,031.

Pennsylvania had the largest output—301,625 short tons, valued at $415,714, as compared with 356,209 tons, valued at $348,327, in 1902, a decrease in quantity of 54,584 tons and an increase in value of $67,387.

Illinois and Missouri followed in rank of output with an increase of production for Illinois and a decrease for Missouri.

Production of glass sand and of other sand in the United States in 1902 and 1903, by States.

1903.

State.	Glass sand.		Engine sand.		Furnace sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
California	6,075	$5,225				
Georgia	4,500	4,050				
Illinois	255,440	153,717	15,630	$3,709	61,365	$55,740
Indiana	12,013	8,993				
Maryland	20,900	18,590				
Massachusetts	8,912	17,842				
Missouri	82,232	46,914	8,500	2,550	57,840	31,920
New Jersey	19,720	14,506			56,440	41,089
New York	6,500	5,275	1,000	1,700	2,500	3,125
Ohio	39,603	57,401	7,837	10,553	130,229	134,131
Pennsylvania	301,625	415,714	72,440	66,481	41,662	40,034
West Virginia	65,524	107,601	8,831	7,125		
Total	823,044	855,828	114,238	92,118	350,036	305,949

State.	Building sand.		Other uses.		Total.	
	Quantity.	Value.	Quantity.	Value	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
California					6,075	$5,225
Georgia					4,900	4,410
Illinois	57,245	$27,837	162,818	$94,833	552,493	315,836
Indiana			108,000	83,200	120,013	92,193
Maryland	1,800	1,472	1,000	750	23,700	20,812
Massachusetts			5,571	14,578	14,483	32,420
Missouri	22,000	11,600	58,111	33,062	228,683	125,036
New Jersey	28,000	8,250	34,683	22,156	138,843	85,951
New York	7,800	5,660	19,800	10,608	37,600	26,368
Ohio	3,539	1,906	94,366	95,754	275,574	299,745
Pennsylvania	83,062	61,149	128,362	118,518	627,151	701,896
West Virginia	4,879	4,269	1,911	1,383	81,145	120,378
Total	208,625	122,413	614,717	474,930	2,110,660	1,831,210

Production of glass sand and of other sand in the United States in 1902 and 1903, by States—Continued.

1902.

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

There was a large increase in the value of sand reported for "other uses." This sand was used for glass cutting, core sand, molding sand, sand for filtration, sand for sawing stone, fire sand, etc.

The following table of analyses was published in 1902, but is now republished with numerous additions:

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
Illinois Sand Co	Wedron, Lasalle County, Ill	95.06	.18
Wedron White Sand Co	do	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	
Missouri Silica Co	Pacific, St. Louis County, Mo	99.97	
Pacific Glass Sand Co	do	99.20	.20
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	
Allman Sand Co.:			
No. 1	Massillon, Tuscarawas County, Ohio	98.12	
No. 2	do	97.80	
No. 3	do	96.54	
Sonnhalter Sand and Stone Co	do	99.60	
Layland Stone and Sand Co	Layland, Coshocton County, Ohio	98.78	.04
National Sand Co	Chalfants, Perry County, Ohio	98.506	.014
P. Arnold	Strasburg, Tuscarawas County, Ohio	98.80	Trace.
American Window Glass Co.:[d]			
No. 1	Derry, Westmoreland County, Pa	99.990	[e] .002
No. 2	do	99.714	[e] .020
No. 3	do	99.659	[e] .030
No. 4	do	99.579	[e] .050
Pittsburg Plate Glass Co.:[d]			
No. 1	Pittsburg, Pa	99.21	Trace.
No. 2	do	98.90	.20
No. 3	do	98.95	.10
No. 4	do	98.94	Trace.
Detweiler Sand Co	Columbia, Lancaster County, Pa	99.5044	
Do	do	98.45	.05
American Window Glass Co	Derry, Westmoreland Counry, Pa	98.760	.071
Fitzpatrick Glass Manufacturing Co	Falls Creek, Jefferson County, Pa	99.410	Trace.

[a] Fe_2O_3. [b] FeO. [c] Analysis before same was cleaned.

mined in the United States.

Oxide of iron (Fe_2O_3).	Alumina (Al_2O_3).	Lime (CaO).	Other.	Total.	Authority.
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	
0.02	0.56	....	K_2O	100.00	Prof. A. W. Smith, Case School Applied Science, Cleveland, Ohio.
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.
3.88		.53	....	99.65	Do.
....	.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	
0.56		Trace.	Loss 0.08..........	100.04	Laboratory St. Louis Plate Glass Co.
....	.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.
.30	1.58	....	....	100.00	F. A. Emmerton, Cleveland, Ohio.
.38	.84	....	....	99.02	Do.
.43	3.03	....	....	100.00	Do.
.02	....	.23	Clay, 0.15..........	100.00	Jno. McNamee, Anderson, Ind.
Trace.	.73	.12	Organic, 0.33.....	100.00	F. Schwab, chemist; J. B. Clow & Son, Chicago, Ill.
.09		....	Moisture, 0.60.....	99.210	Professor Horton, Columbus, Ohio.
.084	1.17	Trace.	....	100.004	Dr. Otto Wuth, Pittsburg, Pa.
Trace.	.008	....	....	100.00	Laboratory American Window Glass Co.
.006	.280	....	....	100.020	Do.
.011	.310	....	....	100.000	Do.
.021	.350	....	....	100.000	Do.
.003	.30	.20	Volatile, 0.21.....	99.923	Laboratory Pittsburg Plate Glass Co.
.002	.20	.54	Volatile, 0.25.....	100.092	Do.
.0024	.50	.30	Volatile, 0.24.....	100.0924	Do.
.0036	.30	.40	Volatile, 0.23.....	99.8736	Do.
.2996	.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.

a Sand used by the company.

• Includes CaO.

Analyses of glass sands mined

Operator.	Location of mine or quarry.	Constituent.	
		Silica (SiO_2).	Magnesia (MgO).
Breakneck Sand and Stone Co.:		*Per cent.*	*Per cent.*
No. 1	Connellsville, Fayette County, Pa.	99.17	
No. 2	do	99.83	
No. 3	do	99.23	
No. 4	do	99.19	
No. 5	do	99.09	
No. 6	do	99.12	
No. 7	do	98.77	
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	
R. B. Reid:			
White sample [a]	Randall, Monongalia County, W. Va.	99.04	0.04
Reddish sample [a]	do	98.40	.21

[a] Dried at 110° C.

in the United States—Continued.

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.*	
0.18	0.44	....	Loss on ignition, 0.15.	99.94	Pittsburg Testing Laboratory, Pittsburg, Pa.
.11	.38	....	Loss on ignition, 0.11.	99.93	Do.
.25	.27	....	Loss on ignition, 0.22.	99.97	Do.
.28	.14	....	Loss on ignition, 0.18.	99.79	Do.
.24	.22	....	Loss on ignition, 0.24.	99.79	Do.
.24	.12	....	Loss on ignition, 0.31.	99.79	Do.
.22	.60	....	Loss on ignition, 0.31.	99.90	Do.
.04	.33	....	Moisture, 0.17; cobalt, none.	99.91	Do.
.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.
.12	.60	Trace.	Water and organic, 0.20.	100.00	C. S. Howard, University of West Virginia.
.41	.54	0.04	Water and organic, 0.40.	100.00	Do.

Analyses of European glass sands.

Constituent.	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.

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PUBLICATIONS OF UNITED STATES GEOLOGICAL SURVEY.

[Mineral Resources, 1903.]

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. Out of stock.

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°. 1088 pp.

Mineral Resources of the United States, 1903, David T. Day, chief of division. 1904. 8°. 1204 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—

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Reference.

Day, David Talbot.

see, as chief of Division of mining and mineral resources, 1886–

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