DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
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CONTENTS AND ILLUSTRATIONS.

MINERAL RESOURCES OF THE UNITED STATES, 1904.

David T. Day, *Chief of Division.*

INTRODUCTION.

The arrangement and scope of this volume are practically the same as in the twenty 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 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 23,621,520 short tons, valued at $46,026,183, 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 1904.

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 activity in the mineral industries of the United States noted in 1900, 1901, 1902, and 1903, though the value of the output for 1904 was about 9 per cent less than that for 1903.

In 1904, for the fifth time, the total value of our mineral production exceeded the enormous sum of $1,000,000,000.

The exact figures for 1904 were $1,289,047,146, as compared with $1,419,280,617 in 1903, with $1,260,501,898 in 1902, with $1,086,550,871 in 1901, and with $1,063,678,053 in 1900; a loss in 1904 from 1903 of $130,233,471, or 9.18 per cent; a gain in 1904 over 1902 of $28,545,248, or 2.26 per cent; a gain in 1904 over 1901 of $202,496,275, or 18.64 per cent, and a gain in 1904 over 1900 of $225,369,093 or 21.19 per cent.

As heretofore, iron and coal are the most important of our mineral products. The value of the iron in 1904 was $233,025,000; the value of the coal, $444,816,288. The fuels decreased from $634,226,291 in 1903 to $584,483,514 in 1904, a loss of $49,742,777, or 7.84 per cent. Anthracite coal showed a decrease in value of $13,062,428 from $152,036,448 in 1903 to $138,974,020 in 1904. The average price of anthracite coal per long ton at the mine was $2.35, as against $2.50 in 1903, $2.35 in 1902, $2.05 in 1901, $1.85 in 1900, and $1.80 in 1899; and the average price per short ton for bituminous coal at the mine was $1.10, as compared with $1.24 in 1903 and with $1.12 in 1902. The decrease in value of the bituminous coal output from 1903 was $45,845,665, a combined decrease in value of coal of $58,908,093 in 1904.

The loss of $130,233,471 in the total value of our mineral production is due to losses in both metallic and nonmetallic products, the metallic products showing a decrease from $624,318,008 in 1903 to $541,466,796 in 1904, a loss of $82,851,212, and the nonmetallic products showing a decrease from $793,962,609 in 1903 to $747,180,350 in 1904, a loss of $46,782,259. To these products should be added estimated unspecified products, including molybdenum, bismuth, tungsten, and other mineral products, valued at $400,000 (as against $1,000,000 of unspecified products in 1903), making the total mineral production for 1904 $1,289,047,146.

The manufacture of arsenious oxide, noted for the first time in the United States in the report for 1901, was continued in 1904, but again in decreased proportions as compared with 1902 and 1903.

Statistics of the production of sand for molding, building, engine, and furnace use, and for other purposes, were collected for the first time in 1904.

Included in the volume for 1904 is a brief report calling attention to peat in the United States and to its possibilities as a source of fuel.

Tin was produced commercially, though in small quantities, in South Carolina, South Dakota, and Alaska, and the mines were actively exploited during the year 1904.

In accordance with a provision in the appropriation for Mineral Resources of the United States for the fiscal year 1905–1906 a comprehensive investigation is in progress (November, 1905) to determine what minerals of economic value are contained in the black sands found in the placer mines of the United States. An invitation has been extended through the mails to all the placer miners in the United States to send samples of their heavy concentrates for examination. These have been tested as to their contents of precious metals, and their mineralogy has been exhaustively studied. Where it became evident that these sands contained useful minerals not already being utilized a competent geologist was sent to the deposit, and samples varying in size from 100 pounds to a carload were obtained and examined with concentrating machinery at Portland, Oreg. The results of this investigation will be published in the forthcoming volume of Mineral Resources of the United States for the calendar year 1905.

METALS.

Iron and steel.—Twenty States produced pig iron in 1904, as against 22 in 1903, 22 in 1902, 20 in 1901, and 21 in 1900 and 1899. The total production of pig iron in 1904 was 16,497,033 long tons, as against 18,009,252 long tons in 1903, 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 1904 shows a decrease in quantity of 1,512,219 long tons, or over 8 per cent, from the production of 1903, and a decrease in value from $344,350,000 to $233,025,000, amounting to $111,325,000, or over 32 per cent. The average price per long ton of pig iron decreased from $19.12 in 1903 to $14.13 in 1904. The average prices per long ton in recent years have been as follows: 1902, $20.92; 1901, $15.25; 1900, $18.85; 1899, $18; 1897, $9.85; 1896, $10.47; 1895, $11.14; 1894, $9.75.

Iron ores.—The production of iron ores in 1904 amounted to 27,644,-330 long tons, as compared with 35,019,308 long tons in 1903 and with 35,554,135 long tons in 1902, a loss in 1904 from 1903 of 7,374,978 long tons. The value at the mines of the ore mined in 1904 was $43,-186,741, a loss as compared with the 1903 value, $66,328,415, of $23,141,674. As in the five preceding years, the production of iron ores in the United States in 1904 was never equaled by that of 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, and increased in quantity to 3,146 long tons, valued at $29,466, in 1904. The average price per ton in 1904 was $9.37, as compared with $8.97 in 1903, with $8.15 in 1902, with $9.73 in 1901, and with $8.52 in 1900.

Gold.—The production of gold in 1904, as reported to the Survey, amounted to 3,910,729 fine ounces, as compared with 3,560,000 fine ounces in 1903, 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 $80,835,648, as compared with $73,591,700 in 1903, with $80,000,000 in 1902, with $78,666,700 in 1901, with $79,171,000 in 1900, and with $71,053,409 in 1899.

Silver.—The coining value of the silver produced in 1904 was $72,402,224, as compared with $70,206,060 in 1903, with $71,757,575 in 1902, with $71,387,800 in 1901, and with $74,533,495 in 1900. The production in 1904 was 55,999,864 fine ounces, as compared with 54,300,000 fine ounces in 1903, 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 1904 was $32,035,378, as compared with $29,322,000 in 1903, 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 698,044,517 pounds in 1903 to 812,537,267 pounds in 1904, an increase of 114,492,750 pounds, or about 16 per cent, in quantity, and it increased in value from $91,506,006 in 1903 to $105,629,845 in 1904, an increase of $14,123,839, or about 15 per cent.

Lead.—The production of lead increased to 307,000 short tons in 1904 from 282,000 short tons in 1903. It was 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 1904 was $26,402,000, as compared with $23,520,000 in 1903, 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 1904 showed an increase in quantity as compared with 1903, 1902, and 1901, the production being 186,702 short tons, as compared with 159,219 short tons in 1903, 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 1904 was $18,670,200, as compared with $16,717,995 in 1903, 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 1904 was 8,600,000 pounds, valued at $2,477,000, as compared with 7,500,000 pounds, valued at $2,284,900, in 1903; 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 1904 amounted to 34,570 flasks (of 76½ avoirdupois pounds net; 75 avoirdupois pounds net after June, 1904), as compared with 35,620 flasks in 1903, 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 1904 was $1,503,795, as compared with $1,544,934 in 1903, with $1,467,848 in 1902, with $1,382,305 in 1901, and with $1,302,586 in 1900. California, including Nevada, reported 29,234 flasks, as compared with 30,591 flasks in 1903, with 28,972 flasks in 1902, and with 26,720 flasks in 1901; and Texas reported 5,336 flasks, as against 5,029 flasks in 1903, 5,319 flasks in 1902, and 2,932 flasks in 1901.

Nickel.—The production of metallic nickel reported in 1904 was 24,000 pounds, as against a production of 114,200 pounds in 1903, of 5,748 pounds in 1902, of 6,700 pounds in 1901, of 9,715 pounds in 1900, and of 22,541 pounds in 1899. The value in 1904 was $11,400, as against $45,900 in 1903, $2,701 in 1902, $3,551 in 1901, $3,886 in 1900, and $8,566 in 1899. The imports of nickel in 1904 were valued at $1,121,491, as compared with $1,493,889 in 1903, 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 1904 was 200 ounces, valued at $4,160, as compared with 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), produced in 1903; 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.—The total quantity of antimony obtained from all sources in 1904 was 3,057 short tons, valued at $505,524, as compared with a total production for 1903 of 3,128 short tons, valued at $548,433. No antimony was obtained from domestic ores during 1903. The antimony obtained from the smelting of foreign imported ores in 1904 amounted to 486 short tons, valued at $61,926, and the antimony obtained from hard lead produced from foreign and domestic lead ores was 2,571 short tons, valued at $443,598, a total production for 1904 of 3,057 short tons, valued at $505,524, as compared with 3,128 short tons, valued at $548,433, in 1903; with 3,561 short tons, valued at $634,506, in 1902, and with 2,639 short tons, valued at $539,902, in 1901.

Bismuth.—The marketed production of bismuth ore in 1904 was 5,184 pounds, valued at $314. There was no marketed production of bismuth ores in the United States during 1903 or 1902. The marketed output in 1901 was 318.6 short tons. The ore contained gold and silver, for which the producers were paid. As nearly as can be ascertained, the value of the output in 1901 was $80 per ton, not including charges for transportation or treatment. The price of the refined metal is kept so low by the combination controlling the business that profitable mining of domestic ores is practically out of the question.

Tin.—There was no production of metallic tin in 1904; but about 159 short tons of concentrates were shipped from South Carolina, South Dakota, and Alaska to England, as against 20 short tons of concentrates shipped from South Carolina in 1903; value not given either in 1903 or in 1904.

FUELS.

Coal.—For the third time in the history of the United States the production of coal in 1904 reached a total of over 300,000,000 short tons, showing an actual output of 352,310,427 tons of 2,000 pounds, valued at $444,816,288. Of this total the output of anthracite coal amounted to 65,318,490 long tons (equivalent to 73,156,709 short tons), which, as compared with the production of 66,613,454 long tons in 1903, was a decrease of 1,294,964 long tons, or almost 2 per cent. The value of anthracite coal at the mines in 1904 was $138,974,020, as against $152,036,448 in 1903, $76,173,586 in 1902, and $112,504,020 in 1901. The average value of the marketed coal sold during the year at the mines was $2.35 per long ton, the value in 1903 having been $2.50, in 1902, $2.35, and in 1901, $2.05.

The output of bituminous coal (which includes semianthracite and all semibituminous and lignite coals) amounted in 1904 to 279,153,718 short tons, valued at $305,842,268, as compared with 282,749,348 short tons, valued at $351,687,933, in 1903, with 260,216,844 short tons, valued at $290,858,483, in 1902, and with 225,828,149 short tons, valued at $236,422,049, in 1901. The decrease in the production of bituminous coal in 1904 from 1903 was therefore 3,595,630 short tons in quantity and $45,845,665 in value. The average price per ton at the mines during 1904 was $1.10, as against $1.24 per ton in 1903, the highest price recorded by the Survey.

Coke.—The coke production of the United States in 1904, which included the output from 2,610 retort or by-product ovens, amounted to 23,621,520 short tons, as compared with 25,274,281 short tons in 1903, 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 1904 from 1903 was 1,652,761 short tons, or about 6.5 per cent. The total value was $46,026,183, a loss from the 1903 value, $66,498,664, of $20,472,481. It should be borne in mind that the value for 1903 was in part the abnormal result of the coal strike in 1902.

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 1904 was $51,157,736, as compared with $47,830,600 in 1903 and with $43,869,440 in 1902.

Petroleum.—The total production of crude petroleum in the United States in 1904 was 117,063,421 barrels, as against 100,461,337 barrels in 1903, 88,766,916 barrels in 1902, and 69,389,194 barrels in 1901, an increase of 16,602,084 barrels, or 16.53 per cent, over the production of 1903, and of 31.88 per cent over that of 1902. The increase in 1904 came from California, Kansas and Indian Territory and Oklahoma, Texas, Indiana, Louisiana, and Kentucky and Tennessee, in the order named. In round numbers, the gains in 1904 over 1903 were as follows: California, 5,300,000 barrels; Kansas and Indian Territory and Oklahoma, 4,500,000 barrels; Texas, 4,300,000 barrels; Indiana, 2,200,000 barrels; Louisiana, 2,000,000 barrels; Kentucky and Tennessee, 500,000 barrels. The largest decrease in production in 1904, as compared with 1903, was in Ohio, which showed a decrease of about 1,600,000 barrels, Pennsylvania and New York 280,000 barrels, and West Virginia 260,000 barrels. It will be observed that the greatest gains were in the South and West and in the Lima-Indiana field, and that, relatively, the Appalachian field lost heavily. The value of crude petroleum produced during 1904 was $101,170,466, or 86.42 cents per barrel, as against $94,694,050, or 94.26 cents per barrel, in 1903, and $71,178,910, or 80.19 cents per barrel, in 1902.

Natural gas.—The value of the natural gas produced in 1904 was $38,496,760, as compared with $35,807,860 in 1903, with $30,867,863 in 1902, with $27,066,077 in 1901, with $23,698,674 in 1900, and with $20,074,873 in 1899—a gain of 7.51 per cent in 1904 over 1903.

STRUCTURAL MATERIALS.

Stone.—The value of all kinds of stone produced in the United States during 1904 amounted to $74,200,361, as compared with $72,945,908 in 1903, with $69,830,351 in 1902, with $60,275,762 in 1901, with $48,008,739 in 1900, and with $48,785,875 in 1899.

Clay products.—The activity in all branches of the clay-working industries noted in the reports as true of 1899, 1900, 1901, 1902, and 1903 diminished very slightly during 1904. The value of all clay products, as reported to this office in 1904 was $131,023,248, as against

$131,062,421 in 1903, $122,169,531 in 1902, $110,211,587 in 1901, and $96,212,345 in 1900. The brick and tile products in 1904 were valued at $105,864,978, as against $105,626,369 in 1903, $98,042,078 in 1902, $87,747,727 in 1901, and $76,413,775 in 1900. The pottery products were valued in 1904 at $25,158,270, as against $25,436,052 in 1903, $24,127,453 in 1902, $22,463,860 in 1901, and $19,798,570 in 1900.

The commercial production of clay mined and sold by those not manufacturing the product themselves in 1904 was valued at $2,320,162, as compared with $2,594,042 in 1903, 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 $13,000,000.

Cement.—The total production of hydraulic cement in the United States in 1904 was 31,675,257 barrels, valued at $26,031,920, as compared with 29,899,140 barrels, valued at $31,931,341, in 1903; 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 1904 was 26,505,881 barrels, valued at $23,355,119, as compared with 22,342,973 barrels, valued at $27,713,319, in 1903; 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 in quantity in 1904 as compared with 1903 of 4,162,908 barrels, and a decrease in value of $4,358,200. The production of natural-rock cement in 1904 was 4,866,331 barrels, valued at $2,450,150, as compared with 7,030,271 barrels, valued at $3,675,520, in 1903; 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—a decrease in quantity in 1904 of 2,163,940 barrels, and in value of $1,225,370. The production of slag cement in 1904 amounted to 303,045 barrels, valued at $226,651, as against 525,896 barrels, valued at $542,502, in 1903.

ABRASIVE MATERIALS.

Carborundum.—The production of carborundum in 1904 was 7,060,380 pounds, as compared with 4,759,890 pounds in 1903, with 3,741,500 pounds in 1902, and with 3,838,175 pounds in 1901. The value of the carborundum varies from 8 to 10 cents a pound.

Corundum and emery.—The combined production of corundum and emery in 1904 amounted to 1,932 short tons, valued at $57,235, as against 2,542 short tons, valued at $64,102, in 1903; 4,251 short tons, valued at $104,605, in 1902, and 4,305 short tons, valued at $146,040, in 1901.

Crushed steel.—The production of crushed steel in 1904 was 790,000 pounds, as against 755,000 pounds in 1903, 735,000 pounds in 1902, and 690,000 pounds in 1901.

Crystalline quartz.—In 1904 the production of crystalline quartz included under abrasives amounted to 31,924 short tons, valued at $74,600, as against 8,938 short tons, valued at $76,908, in 1903; 15,104 short tons, valued at $84,335, in 1902, and 14,050 short tons, valued at $41,500, in 1901.

Garnet.—The production of abrasive garnet in the United States during 1904 amounted to 3,854 short tons, valued at $117,581, as against 3,950 short tons, valued at $132,500, in 1903; 3,926 short tons, valued at $132,820, in 1902, and 4,444 short tons, valued at $158,100, in 1901. The average price for the 1904 production is reported as $30.51 per ton.

Grindstones.—The total value of all kinds of grindstones produced during 1904 was $881,527, as against $721,446 in 1903, $667,431 in 1902, and $580,703 in 1901. The production of 1904 was the largest on record for any year. It should be remembered, however, that the price, which was from $15 to $18 per ton, has decreased 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 1904 amounted in value to $93,152, as against $85,705 in 1903, $76,906 in 1902, and $88,871 in 1901.

Infusorial earth and tripoli.—In 1904 the production of infusorial earth and tripoli amounted to 6,274 short tons, valued at $44,164, as against 9,219 short tons, valued at $76,273, in 1903; 5,665 short tons, valued at $53,244, in 1902, and 4,020 short tons, valued at $52,950, in 1901.

Millstones and buhrstones.—The value of the production of millstones and buhrstones in 1904 was $37,338, as against $52,552 in 1903, $59,808 in 1902, and $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. From 1894 to 1902 there was a gradual increase in the production, but there was a decrease in both 1903 and 1904.

Oilstones and whetstones.—There was a decided decrease in the commercial domestic production of oilstones and whetstones during 1904, the value falling from $366,857 in 1903 to $188,985 in 1904. The production was valued at $221,762 in 1902 and $158,300 in 1901.

Pumice.—The production of pumice amounted in 1904 to 1,530 short tons, valued at $5,421, as against 885 short tons, valued at $2,665, in 1903, and 700 short tons, valued at $2,750, in 1902.

CHEMICAL MATERIALS.

Arsenious oxide.—The domestic production of arsenious oxide (white arsenic) in 1904 was 36 short tons, valued at $2,185, as compared with 611 short tons, valued at $36,691, in 1903; with 1,353 short tons, valued at $81,180, in 1902, and with 300 short tons, valued at $18,000, in 1901.

Borax.—The reported returns for 1904 gave an aggregate production of crude borax of 45,647 short tons, valued at $698,810, as compared with 34,430 short tons, valued at $661,400, in 1903, and 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 1904, including the amount of bromine contained in potassium bromide, amounted to 897,100 pounds, valued at $269,130, as compared with 598,500 pounds, valued at $167,580, in 1903; with 513,893 pounds, valued at $128,472, in 1902, and with 552,043 pounds, valued at $154,572, in 1901.

Fluorspar.—The total commercial production of fluorspar in 1904 was 36,452 short tons, valued at $234,755, as compared with 42,523 short tons, valued at $213,617, in 1903; with 48,018 short tons, valued at $271,832, in 1902, and with 19,586 short tons, valued at $113,803, in 1901—a decrease in quantity in 1904 of 6,071 short tons, but an increase of $21,138 in value over 1903. The average price of crude fluorspar in 1904 was reported as $4.97, or 69 cents per ton more than the 1903 price, $4.28, but 22 cents less than the 1902 price, $5.19; and the average price of ground fluorspar in 1904 was $8.44 per ton, a decrease of $1.55 from the 1903 price, $9.99, and of $1.54 from the 1902 price, $9.98.

Gypsum.—The output of crude gypsum in 1904 was 940,917 short tons, valued in its first marketable condition at $2,784,325, as compared with 1,041,704 short tons, valued in its first marketable condition at $3,792,943, in 1903; with 816,478 short tons, valued 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 late years is attributable to the largely increased use of wall plaster and 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 1904 was 18,989 short tons, valued at $13,145; in 1903 it was 34,211 short tons, valued at $22,521, and 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 1904 amounted to 1,874,428 long tons, valued at $6,873,625, as compared with 1,581,576 long tons, valued at $5,319,294, in 1903; 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 in 1904 over 1903 of 292,852 tons, and in value of $1,554,331. The total quantity of phosphate rock reported as mined during 1904 was 1,991,169 long tons, as against 1,618,799 long tons in 1903 and 1,499,617 long tons in 1902.

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 1904 amounted to 22,030,002 barrels of 280 pounds, valued at $6,021,222, as compared with 18,968,089 barrels, valued at $5,286,988, in 1903; 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 combined domestic production in 1904 of sulphur and of pyrite for the manufacture of sulphuric acid amounted to 333,542 long tons, valued at $3,460,863, a considerable increase as compared with 233,127 long tons, valued at $1,109,818, produced in 1903; with 207,874 long tons, valued at $947,089, in 1902, and with 241,691 long tons, valued at $1,257,879, in 1901.

PIGMENTS.

Barytes.—The production of crude barytes in 1904 was 65,727 short tons, valued at $174,958, as compared with 50,397 short tons, valued at $152,150, in 1903; 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 production of cobalt oxide reported in 1904 was 22,000 pounds, valued at $42,600; in 1903 it was 120,000 pounds, valued at $228,000 (not including the value of 60 short tons of cobalt ore); in 1902 it was 3,730 pounds, valued at $6,714, and in 1901 it was 13,360 pounds, valued at $24,048. All the cobalt oxide was obtained as a by-product in smelting lead ores at Mine La Motte, Mo.

Mineral paints.—The commercial production of mineral paints in 1904 amounted to 59,785 short tons, valued at $631,171, as compared with 63,687 short tons, valued at $635,557, in 1903; 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 1904 amounted to 63,363 short tons, valued at $4,808,482, as compared with 62,962 short tons, valued at $4,801,718, in 1903; 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 1904 was obtained chiefly from deposits in Georgia and Virginia, with a small quantity from Massachusetts. The total commercial production was 1,480 short tons, valued at $25,740, as against 887 short tons, valued at $16,760, in 1903, and 1,005 short tons, valued at $16,200, in 1902.

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 1904 was 81,572 short tons, valued at $903,741, as against 101,255 short tons, valued at $1,005,446, in 1903, 105,458 short tons, valued at $765,048, in 1902, and 63,134 short tons, valued at $555,335, in 1901.

Bauxite.—In 1904 the production of bauxite was 47,661 long tons, valued at $235,704, as compared with 48,087 long tons, valued at $171,306, in 1903; with 27,322 long tons, valued at $120,366, in 1902, and with 18,905 long tons, valued at $79,914, in 1901.

Chromic iron ore.—California was the only State producing chromite during 1904, the quantity being 123 long tons, valued at $1,845, as compared with 150 long tons, valued at $2,250, in 1903; 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 1904 was 45,188 short tons, valued at $266,326, as against 41,891 short tons, valued at $256,733, in 1903; 45,287 short tons, valued at $250,424, in 1902, and 34,741 short tons, valued at $220,422, in 1901—an increase in 1904 over 1903 of 3,297 tons in quantity and of $9,593 in value.

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 1904 the production was 64,005 short tons, valued at $507,400, as against 60,230 short tons, valued at $421,600, in 1903; 71,100 short tons, valued at $615,350, in 1902; and 69,200 short tons, valued at $483,600, in 1901.

Flint.—The production of flint in 1904 was 52,270 short tons, valued at $100,590, as against 55,233 short tons, valued at $156,947, in 1903; 36,365 short tons, valued at $144,209, in 1902; and 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 1904 was 29,480 short tons, valued at $168,500, as compared with 20,693 short tons, valued at $190,277, in 1903, with 11,492 short tons, valued at $98,144, in 1902, and with 14,112 short tons, valued at $96,835, in 1901.

Glass sand.—The production of glass sand in 1904 was 858,719 short tons, valued at $796,492, as against 823,044 short tons, valued at $855,828, in 1903, and 943,135 short tons, valued at $807,797, in 1902.

Graphite.—The commercial production of crystalline graphite during 1904 amounted to 5,681,177 pounds, valued at $238,447, as compared with 4,538,155 pounds, valued at $154,170, in 1903; 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 1904 was 19,115 short tons, valued at $102,925, as compared with 16,591 short tons, valued at $71,384, in 1903; 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 in 1904 was 3,248,000 pounds, valued at $217,790, the average price being 6.71 cents per pound, as compared with 2,620,000 pounds, valued at $178,670, in 1903, when the average price was 6.82 cents per pound, and with 2,358,828 pounds, valued at $110,700 in 1902, when the average price was 4.70 cents per pound.

Limestone for iron flux.—The quantity of limestone used for fluxing in blast furnaces in 1904 was 10,657,038 long tons, valued at $4,702,768, as compared with 12,029,719 long tons, valued at $5,423,732, in 1903; with 12,139,248 long tons, valued at $5,271,252, in 1902, and with 8,540,168 long tons, valued at $4,659,836, in 1901, the decrease in 1904 being due to idleness of furnaces during the year.

Lithium minerals.—The production of lithium minerals in 1904 was 577 short tons, valued at $5,155, a decrease of 578 short tons in quantity and of $18,270 in value from the 1903 production of 1,155 short tons, valued at $23,425. Of this 1904 production the greater part was spodumene from South Dakota.

Magnesite.—The production of magnesite in the United States continues to be limited to California. During the year 1904 the commercial production reported was 2,850 short tons, valued at $9,298, as compared with 3,744 short tons, valued at $10,595, in 1903, and with 2,830 short tons, valued at $8,490, in 1902.

Mica.—The total production of mica in 1904 was 668,358 pounds of sheet mica, valued at $109,462, and 1,096 short tons of scrap mica, valued at $10,854, as against 619,600 pounds of sheet mica, valued at $118,088, and 1,659 short tons of scrap mica, valued at $25,040, produced in 1903, and against a total value of $118,849 for the production of 1902.

Mineral waters.—The total production of mineral waters in 1904 was 67,718,500 gallons, valued at $10,398,450, as compared with 51,242,757 gallons, valued at $9,041,078, in 1903; 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 1904 was 14.5 short tons of concentrates, valued at $2,175, as against 795 short tons of concentrates, valued at $60,865, in 1903. The value of molybdenum ores fluctuates very greatly.

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. In 1904 the production amounted to 745,999 pounds (including small quantities of zircon, columbite, and gadolinite), valued at $85,038, as compared with 865,000 pounds, valued at $65,200 (including 3,000 pounds of zircon, valued at $570), produced in 1903; with 802,000 pounds of monazite, valued at

$64,160, in 1902, and with 748,736 pounds, valued at $59,262, in 1901—a decrease in 1904 of 119,001 pounds in quantity, but an increase in value of $19,838, as compared with 1903.

Peat.—The production of peat in 1904 is estimated as amounting to about 1,200 short tons, valued at $4,200.

Potassium salts.—There was no production of potassium salts in the United States in 1904; the imports amounted to 216,182,603 pounds, valued at $3,651,808.

Precious stones.—The value of the gems and precious stones found in the United States in 1904 was $324,300, as against $307,900 in 1903, $328,450 in 1902, and $289,050 in 1901. 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 sapphires 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.

Rutile.—Rutile to the value of $7,000 was reported in 1904.

Sands, molding, building, engine, etc.—The production of sands for molding, building, engine, furnace, and other purposes reported in 1904 was 9,821,009 short tons, valued at $4,951,607.

Talc and soapstone.—Exclusive of the production of fibrous talc from Gouverneur, N. Y., the production of talc and soapstone in 1904 amounted to 27,184 short tons, valued at $433,331, as compared with 26,671 short tons, valued at $418,460, in 1903; with 26,854 short tons, valued at $525,157, in 1902; with 28,643 short tons, valued at $424,888, in 1901, and with 27,943 short tons, valued at $383,541, in 1900.

Tungsten.—The commercial production of concentrated tungsten ores during 1904 amounted to 740 short tons, valued at $184,000, as against 292 short tons, valued at $43,639, in 1903, and 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.

Uranium and vanadium.—The production of uranium and vanadium minerals in 1904, as reported to the Survey, amounted to about 45 short tons of crude and concentrated ore, valued at $10,600, as against 30 short tons of concentrates, equivalent to about 19 short tons of metal, valued at $5,625, in 1903, and 3,810 short tons of crude ore, valued at $48,125, in 1902.

Mineral products of the United

	Product.	1903. Quantity.	1903. Value.
	METALLIC.		
1	Pig iron (spot value) .... long tons..	18,009,252	$344,350,000
2	Silver, coining value .... troy ounces..	54,300,000	70,206,060
3	Gold, coining value .... do....	3,560,000	73,591,700
4	Copper, value at New York City .... pounds..	698,044,517	91,506,006
5	Lead, value at New York City .... short tons..	282,000	23,520,000
6	Zinc, value at New York City .... do....	159,219	16,717,995
7	Quicksilver, value at San Francisco .... [a] flasks..	35,620	1,544,934
8	Aluminum, value at Pittsburg .... pounds..	7,500,000	2,284,900
9	Antimony, value at San Francisco .... short tons..	3,128	548,433
10	Nickel, value at Philadelphia .... pounds..	114,200	45,900
11	Tin .... do....	([c])	....
12	Platinum, value (crude) at San Francisco .... troy ounces..	110	2,080
13	Total value of metallic products	....	624,318,008
	NONMETALLIC (spot values).		
14	Bituminous coal .... short tons..	282,749,348	351,687,933
15	Pennsylvania anthracite .... long tons..	66,613,454	152,036,448
16	Natural gas	....	35,807,860
17	Petroleum .... barrels..	100,461,337	94,694,050
18	Brick clay	....	15,000,000
19	Cement .... barrels..	29,899,140	31,931,341
20	Stone	....	72,945,908
21	Corundum and emery .... short tons..	2,542	64,102
22	Crystalline quartz .... do....	8,938	76,908
23	Garnet for abrasive purposes .... do....	3,950	132,500
24	Grindstones	....	721,446
25	Infusorial earth and tripoli .... short tons..	9,219	76,273
26	Millstones	....	52,552
27	Oilstones, etc	....	366,857
28	Arsenious oxide .... short tons..	611	36,691
29	Borax (crude) .... do....	34,430	661,400
30	Bromine .... do....	598,500	167,580
31	Fluorspar .... short tons..	42,523	213,617
32	Gypsum .... do....	1,041,704	3,792,943
33	Lithium minerals .... do....	1,155	23,425
34	Marls .... do....	34,211	22,521
35	Phosphate rock .... long tons..	1,581,576	5,319,294
36, 37	Pyrite... } Sulphur[d] } .... do....	233,127	1,109,818
38	Salt .... barrels..	18,968,089	5,286,988
39	Barytes (crude) .... short tons..	50,397	152,150
40	Cobalt oxide .... pounds..	120,000	228,000
41	Mineral paints .... short tons..	63,687	635,557
42	Zinc white .... do....	62,962	4,801,718
43	Asbestos .... short tons..	887	16,760
44	Asphaltum .... do....	101,255	1,005,446
45	Bauxite .... long tons..	48,087	171,306
46	Chromic iron ore .... do....	150	2,250
47	Clay (all other than brick) .... short tons..	1,641,835	2,594,042
48	Feldspar .... do....	41,891	256,733
49	Fibrous talc .... do....	60,230	421,600
50	Flint .... do....	55,233	156,947
51	Fuller's earth .... do....	20,693	190,277
52	Glass sand .... do....	823,044	855,828
53	Graphite { Crystalline .... pounds..	4,538,155	225,554
	Graphite { Amorphous .... short tons..	16,591	
54	Magnesite .... do....	3,744	10,595
55	Manganese ore .... long tons..	2,825	25,335
56	Mica { Sheet .... pounds..	619,600	118,088
	Mica { Scrap .... short tons..	1,659	25,040
57	Mineral waters .... gallons sold..	51,242,757	9,041,078
58	Monazite .... pounds..	862,000	64,630
59	Zircon .... do....	3,000	570
60	Precious stones	....	307,900
61	Pumice stone .... short tons..	885	2,665
62	Rutile .... pounds..	....	....
63	Sand, molding, building, etc .... short tons..	....	....
64	Talc and soapstone .... do....	26,671	418,460
65	Uranium and vanadium .... do....	30	5,625
66	Total value of nonmetallic mineral products	....	793,962,609
67	Total value of metallic products	....	624,318,008
68	Estimated value of mineral products unspecified	....	1,000,000
69	Grand total	....	1,419,280,617

[a] Of 76½ avoirdupois pounds net; 75 avoirdupois pounds net after June, 1904.
[b] Consumption in 1904.

States in 1903 and 1904.

1904.		Increase (+) or decrease (—) in 1904.		Per cent of increase (+) or decrease (—).		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
16,497,033	$233,025,000	— 1,512,219	—$111,325,000	— 8.40	— 32.33	1
55,999,864	72,402,224	+ 1,699,864	+ 2,196,164	+ 3.13	+ 3.13	2
3,910,729	80,835,648	+ 350,729	+ 7,243,948	+ 9.85	+ 9.85	3
812,537,267	105,629,845	+114,492,750	+ 14,123,839	+ 16.40	+ 15.43	4
307,000	26,402,000	+ 25,000	+ 2,882,000	+ 8.87	+ 12.25	5
186,702	18,670,200	+ 27,483	+ 1,952,205	+ 17.26	+ 11.68	6
34,570	1,503,795	— 1,050	— 41,139	— 2.95	— 2.66	7
b 8,600,000	b 2,477,000	+ 1,100,000	+ 192,100	+ 14.67	+ 8.41	8
3,057	505,524	— 71	— 42,909	— 2.27	— 7.82	9
24,000	11,400	— 90,200	— 34,500	— 78.98	— 75.16	10
(c)						11
200	4,160	+ 90	+ 2,080	+ 81.82	+100.00	12
....	541,466,796	....	— 82,851,212	....	— 13.27	13
279,153,718	305,842,268	— 3,595,630	— 45,845,665	— 1.27	— 13.04	14
65,318,490	138,974,020	— 1,294,964	— 13,062,428	— 1.94	— 8.59	15
....	38,496,760	....	+ 2,688,900	....	+ 7.51	16
117,063,421	101,170,466	+ 16,602,084	+ 6,476,416	+ 16.53	+ 6.84	17
....	13,000,000	....	— 2,000,000	....	— 13.33	18
31,675,257	26,031,920	+ 1,776,117	— 5,899,421	+ 5.94	— 18.48	19
....	74,200,361	....	+ 1,254,453	....	+ 1.72	20
1,932	57,235	— 610	— 6,867	— 24.00	— 10.71	21
31,924	74,600	+ 22,986	— 2,308	+257.17	— 3.00	22
3,854	117,581	— 96	— 14,919	— 2.43	— 11.26	23
....	881,527	....	+ 160,081	....	+ 22.19	24
6,274	44,164	— 2,945	— 32,109	31.94	— 42.10	25
....	37,338	....	— 15,214	....	— 28.95	26
....	188,985	....	— 177,872	....	— 48.49	27
36	2,185	— 575	— 34,506	— 94.11	— 94.04	28
45,647	698,810	+ 11,217	+ 37,410	+ 32.58	+ 5.66	29
897,100	269,130	+ 298,600	+ 101,550	+ 49.89	+ 60.60	30
36,452	234,755	— 6,071	+ 21,138	— 14.28	+ 9.90	31
940,917	2,784,325	— 100,787	— 1,008,618	— 9.68	— 26.59	32
577	5,155	— 578	— 18,270	— 50.04	— 77.99	33
18,989	13,145	— 15,222	— 9,376	— 44.49	— 41.63	34
1,874,428	6,873,625	+ 292,852	+ 1,554,331	+ 18.52	+ 29.22	35
333,542	3,460,863	+ 100,415	+ 2,351,045	+ 43.07	+211.84	36 37
22,030,002	6,021,222	+ 3,061,913	+ 734,234	+ 16.14	+ 13.89	38
65,727	174,958	+ 15,330	+ 22,808	+ 30.42	+ 14.99	39
22,000	42,600	— 98,000	— 185,400	— 81.67	— 81.32	40
59,785	631,171	— 3,902	4,386	— 6.13	— .69	41
63,363	4,808,482	+ 401	+ 6,764	+ .64	+ .14	42
1,480	25,740	+ 593	+ 8,980	+ 66.85	+ 53.58	43
81,572	903,741	— 19,683	— 101,705	— 19.44	— 10.12	44
47,661	235,704	— 426	+ 64,398	— .89	+ 37.59	45
123	1,845	— 27	— 405	18.00	— 18.00	46
1,508,752	2,320,162	— 133,083	— 273,880	— 8.11	— 10.56	47
45,188	266,326	+ 3,297	+ 9,593	+ 7.87	+ 3.74	48
64,005	507,400	+ 3,775	+ 85,800	+ 6.27	+ 20.35	49
52,270	100,590	— 2,963	— 56,357	— 5.36	— 35.91	50
29,480	168,500	+ 8,787	— 21,777	+ 42.46	— 11.44	51
858,719	796,492	+ 35,675	— 59,336	+ 4.33	— 6.93	52
5,681,177 19,115	341,372	+ 1,143,022 + 2,524	+ 115,818	+ 25.19 + 15.21	+ 51.35	53
2,850	9,298	— 894	— 1,297	— 23.88	— 12.24	54
3,146	29,466	+ 321	+ 4,131	+ 11.36	+ 16.31	55
668,358 1,096	109,462 10,854	+ 48,758 — 563	— 8,626 — 14,186	+ 7.87 — 33.94	— 7.30 — 56.65	56
67,718,500	10,398,450	+ 16,475,743	+ 1,357,372	+ 32.15	+ 15.01	57
745,999	85,038	— 119,001	+ 19,838	— 13.76	+ 30.43	58 59
....	324,300	....	+ 16,400	....	+ 5.33	60
1,530	5,421	+ 645	+ 2,756	+ 72.88	+103.41	61
....	7,000	....	+ 7,000	....	....	62
....	4,951,607	....	+ 4,951,607	....	....	63
27,184	433,331	+ 513	+ 14,871	+ 1.92	+ 3.55	64
45	10,600	+ 15	+ 4,975	+ 50.00	+ 88.44	65
....	747,180,350	....	— 46,782,259	....	— 5.89	66
....	541,466,796	....	— 82,851,212	....	— 13.27	67
....	400,000	....	— 600,000	....	— 60.00	68
....	1,289,047,146	....	— 130,233,471	....	— 9.18	69

c No metallic tin; concentrates shipped. d Sulphur included under pyrite since 1901.

Mineral products of the United States

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

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

for the calendar years 1880–1904.

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

Mineral products of the United States for

	Product.	1884.	
		Quantity.	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 ... short tons..	73,730,539	77,417,066
14	Pennsylvania anthracite ... long tons..	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 1880-1904—Continued.

1885.		1886.		1887.		
Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
4,044,425	$64,712,400	5,683,329	$95,195,760	6,417,148	$121,925,800	1
39,910,279	51,600,000	39,445,312	51,000,000	41,269,240	53,350,000	2
1,538,376	31,800,000	1,881,250	35,000,000	1,596,500	33,000,000	3
170,962,607	18,292,999	161,235,381	16,527,651	185,227,331	21,115,916	4
129,412	10,469,431	130,629	12,200,749	145,700	13,113,000	5
40,688	3,539,856	42,641	3,752,408	50,340	4,782,300	6
32,073	979,189	29,981	1,060,000	33,825	1,429,000	7
277,904	179,975	214,992	127,157	205,566	133,200	8
283	2,550	3,000	27,000	18,000	59,000	9
50	10,000	35	7,000	75	15,000	10
250	187	50	100	448	1,838	11
....	181,586,587	....	214,897,825	....	248,925,054	12
64,840,668	82,347,648	73,707,957	78,481,056	87,887,360	98,004,656	13
34,228,548	76,671,948	34,853,077	76,119,120	37,578,747	84,552,181	14
....	19,000,000	....	19,000,000	....	25,000,000	15
21,847,205	19,198,243	28,064,841	19,996,313	28,278,866	18,877,094	16
40,000,000	20,000,000	....	....	....	....	17
....	4,857,200	....	10,012,000	....	15,817,500	18
....	....	....	6,200,000	....	7,000,000	19
40,320	275,000	44,800	325,000	48,160	340,000	20
4,150,000	3,492,500	4,500,000	3,990,000	6,692,744	5,674,377	21
7,038,653	4,825,345	7,707,081	4,736,585	7,831,962	4,093,846	22
437,856	2,846,064	430,549	1,872,936	480,558	1,836,818	23
3,356,956	1,678,478	4,717,163	2,830,297	5,377,000	3,226,200	24
9,148,401	1,312,845	8,950,317	1,284,070	8,259,609	1,261,463	25
15,000	1,050,000	18,000	1,440,000	18,000	1,440,000	26
3,950	43,575	18,800	315,000	22,000	330,000	27
8,000,000	480,000	9,778,290	488,915	11,000,000	550,000	28
90,405	405,000	95,250	428,625	95,000	425,000	29
....	500,000	....	250,000	....	224,400	30
10,000	110,000	12,000	125,000	15,000	160,000	31
49,000	220,500	55,000	220,000	52,000	210,000	32
10,000	200,000	12,000	225,000	12,000	225,000	33
23,258	190,281	30,193	277,636	34,524	333,844	34
3,000	10,500	3,500	14,000	4,000	16,000	35
....	209,900	....	119,056	....	163,600	36
310,000	89,900	428,331	141,350	199,087	61,717	37
600	108,000	645	116,190	600	108,000	38
15,000	75,000	10,000	50,000	15,000	75,000	39
327,883	26,231	415,525	33,242	416,000	34,000	40
....	100,000	....	140,000	....	100,000	41
1,000,000	15,000	1,160,000	15,000	1,200,000	16,000	42
875,000	437,500	800,000	400,000	600,000	300,000	43
30 000	120,000	30,000	120,000	32,000	128,000	44
5,000	22,500	5,000	22,000	5,000	20,000	45
2,700	40,000	2,000	30,000	3,000	40,000	46
1,000	5,000	1,200	6,000	3,000	15,000	47
13,600	68,000	14,900	74,500	10,200	61,200	48
92,000	161,000	40,000	70,000	70,000	142,250	49
68,723	65,373	35,000	36,878	18,340	18,774	50
1,975	24,687	....	....	....	....	51
715	17,875	2,500	75,000	3,000	100,000	52
300	9,000	200	6,000	150	4,500	53
600	2,000	600	2,000	1,000	3,000	54
....	....	....	....	....	....	55
....	241,312,093	....	230,088,769	....	270,989,420	56
....	181,586,587	....	214,897,825	....	248,925,054	57
....	5,000,000	....	800,000	....	800,000	58
....	427,898,680	....	445,786,594	....	520,714,474	59

Mineral products of the United States for

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

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

the calendar years 1880–1904—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	47,732	681,992	49,652	678,478	29
....	439,587	....	450,000	....	476,113	30
23,746	241,170	41,354	389,196	53,054	493,068	31
51,735	171,537	40,841	190,416	45,054	242,264	32
12,715	231,708	13,670	252,309	16,514	243,981	33
....	188,807	....	118,833	....	235,300	34
93,705	202,119	99,854	273,745	106,536	338,880	35
2,245	105,565	1,970	89,395	2,265	90,230	36
5,982,000	32,980	....	69,909	1,375,000	150,000	37
49,500	50,000	60,000	75,000	75,000	100,000	38
19,161	106,313	21,911	86,505	31,069	118,363	39
418,891	125,667	387,847	104,719	343,000	54,880	40
9,500	45,835	8,250	55,328	10,044	78,330	41
6,970	39,370	8,000	45,200	10,000	50,000	42
24,197	240,559	25,684	219,050	23,416	239,129	43
21,113	89,730	13,000	57,400	15,000	60,000	44
....	72,662	....	77,500	....	110,000	45
728	2,366	1,844	6,012	3,593	11,675	46
1,150	7,850	....	....	1,200	39,600	47
139,522	63,956	153,620	69,880	135,000	67,500	48
3,466	23,372	2,532	50,240	....	21,988	49
....	35,155	....	23,720	....	16,587	50
2,000	30,000	3,599	53,985	1,372	20,580	51
13,955	31,092	6,788	16,291	7,200	18,000	52
....	....	....	....	439	4,390	53
30	1,800	71	4,560	66	3,960	54
1,000	3,000	400	1,000	300	800	55
56,000	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 for

	Product.	1892. Quantity.	Value.
	METALLIC.		
1	Pig iron, spot value ....long tons..	9,157,000	$131,161,039
2	Silver, coining value ....troy ounces..	63,500,000	82,101,000
3	Gold, coining value ....do....	1,596,375	33,000,000
4	Copper, value at New York City ....pounds..	352,971,744	37,977,142
5	Lead, value at New York City ....short tons..	173,654	13,892,320
6	Zinc, value at New York City ....do....	87,260	8,027,920
7	Quicksilver, value at San Francisco ....flasks..	27,993	1,245,689
8	Aluminum, value at Pittsburg ....pounds..	259,885	172,824
9	Antimony, value at San Francisco ....short tons..	1,790	276,416
10	Nickel, value at Philadelphia ....pounds..	92,252	50,739
11	Tin ....do....	162,000	32,400
12	Platinum, value (crude) at San Francisco ....troy ounces..	80	550
13	Total value of metallic products....	....	307,938,039
	NONMETALLIC (SPOT VALUES).		
14	Bituminous coal ....short tons..	126,856,567	125,124,381
15	Pennsylvania anthracite ....long tons..	46,850,450	82,442,000
16	Natural gas	....	14,800,714
17	Petroleum ....barrels..	50,509,136	26,034,196
18	Brick clay	....	9,000,000
19	Cement ....barrels..	8,758,621	7,152,750
20	Stone	....	48,706,625
21	Corundum and emery ....short tons..	1,771	181,300
22	Crystalline quartz ....do....	....	....
23	Garnet for abrasive purposes ....do....	....	....
24	Grindstones	....	272,244
25	Infusorial earth and tripoli ....short tons..	....	43,655
26	Millstones	....	23,417
27	Oilstones, etc	....	146,730
28	Borax ....pounds..	13,500,000	900,000
29	Bromine ....do....	379,480	64,502
30	Fluorspar ....short tons..	12,250	89,000
31	Gypsum ....do....	256,259	695,492
32	Marls ....do....	125,000	65,000
33	Phosphate rock ....long tons..	681,571	3,296,227
34	Pyrite ....do....	109,788	305,191
35	Salt ....barrels..	11,698,890	5,654,915
36	Sulphur ....short tons..	2,688	80,640
37	Barytes (crude) ....do....	32,108	130,025
38	Cobalt oxide ....pounds..	7,869	15,738
39	Mineral paints ....short tons..	51,704	767,766
40	Zinc white ....do....	27,500	2,200,000
41	Asbestos ....do....	104	6,416
42	Asphaltum ....do....	87,680	445,375
43	Bauxite ....long tons..	10,518	34,183
44	Chromic iron ore ....do....	1,500	25,000
45	Clay (all other than brick) ....short tons..	470,400	1,000,000
46	Feldspar ....do....	16,800	75,000
47	Fibrous talc ....do....	41,925	472,485
48	Flint ....do....	22,400	80,000
49	Fuller's earth ....do....	....	....
50	Graphite ....pounds..	....	104,000
51	Limestone for iron flux ....long tons..	5,172,114	3,620,480
52	Magnesite ....short tons..	1,004	10,040
53	Manganese ore ....long tons..	13,613	129,586
54	Mica ....pounds....	75,000	100,000
55	Mineral waters ....gallons sold..	21,876,604	4,905,970
56	Monazite ....pounds....	....	....
57	Ozocerite (refined) ....do....	60,000	8,000
58	Precious stones	....	312,050
59	Pumice stone ....short tons..	....	....
60	Rutile ....pounds..	100	300
61	Soapstone ....short tons..	23,908	437,449
62	Total value of nonmetallic mineral products....	....	339,958,842
63	Total value of metallic products....	....	307,938,039
64	Estimated value of mineral products unspecified	....	1,000,000
65	Grand total	....	648,896,881

the calendar years 1880–1904—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	*a* 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	115,779,771	14
48,185,306	85,687,078	46,358,144	78,488,063	51,785,122	82,019,272	15
....	14,346,250	....	13,954,400	....	13,006,650	16
48,412,666	28,932,326	49,344,516	35,522,095	52,892,276	57,632,296	17
....	9,000,000	....	9,000,000	....	9,000,000	18
8,002,467	6,262,841	8,362,245	5,030,081	8,731,401	5,482,254	19
....	33,885,573	....	36,534,788	....	33,319,131	20
1,713	142,325	1,495	95,936	2,102	106,256	21
....	....	6,024	18,054	9,000	27,000	22
....	....	....	....	3,325	95,050	23
....	338,787	....	223,214	....	205,768	24
....	22,582	2,584	11,718	4,954	20,514	25
....	16,645	....	13,887	....	22,542	26
....	135,173	....	136,873	....	155,881	27
8,699,000	652,425	14,680,130	974,445	11,918,000	595,900	28
348,399	104,520	379,444	102,450	517,421	134,343	29
12,400	84,000	7,500	47,500	4,000	24,000	30
253,615	696,615	239,312	761,719	265,503	797,447	31
75,000	40,000	75,000	40,000	60,000	30,000	32
941,368	4,136,070	996,949	3,479,547	1,038,551	3,606,094	33
75,777	256,552	105,940	363,134	99,549	322,845	34
11,816,772	4,054,668	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	530,384	41,926	498,093	50,695	621,552	39
24,059	1,804,420	19,987	1,399,090	20,710	1,449,700	40
50	2,500	325	4,463	795	13,525	41
47,779	372,232	60,570	353,400	68,163	348,281	42
9,079	29,507	11,066	35,818	17,069	44,000	43
1,450	21,750	3,680	53,231	1,740	16,795	44
448,000	900,000	403,200	800,000	403,200	800,000	45
20,578	68,307	19,264	167,000	8,523	30,000	46
35,861	403,436	39,906	435,060	39,240	370,897	47
33,231	63,792	42,560	319,200	13,747	21,038	48
....	....	....	....	6,900	41,400	49
843,103	63,232	918,000	64,010	....	52,582	50
3,958,055	2,374,833	3,698,550	1,849,275	5,247,949	2,623,974	51
704	7,040	1,440	10,240	2,220	17,000	52
7,718	66,614	6,308	53,635	9,547	71,769	53
66,971	88,929	....	52,388	....	55,831	54
23,544,495	4,246,734	21,569,608	3,741,846	21,463,543	4,254,237	55
130,000	7,600	546,855	36,193	1,573,000	137,150	56
....	....	....	....	....	....	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	....	338,287,291	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	....	620,767,222	65

a Including copper made from imported pyrites.

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	....	32,202,661
21	Corundum and emery....short tons..	2,120	113,246
22	Crystalline quartz....do....	6,000	18,000
23	Garnet for abrasive purposes....do....	2,686	68,877
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....	224,254	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	552,955
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	Fuller's earth ....do....	9,872	59,360
50	Graphite (crystalline)....pounds..	535,858	48,460
51	Graphite (amorphous)....short tons..	760	
52	Magnesite ....do....	1,500	11,000
53	Manganese ore....long tons..	10,088	90,727
54	Mica (sheet) ....pounds..	49,156	65,441
55	Mica (scrap)....short tons..	222	1,750
56	Mineral waters....gallons sold..	25,795,312	4,136,192
57	Monazite ....pounds..	30,000	1,500
58	Ozocerite (refined) ....do....	....	....
59	Precious stones	....	97,850
60	Pumice stone....short tons..	....	....
61	Rutile ....pounds..	100	350
62	Soapstone ....short tons..	22,183	354,065
63	Total value of nonmetallic mineral products	....	334,045,487
64	Total value of metallic products....	....	287,860,155
65	Estimated value of mineral products unspecified	....	1,000,000
66	Grand total	....	622,905,642

the calendar years 1880–1904—Continued.

1897. Quantity.	1897. Value.	1898. Quantity.	1898. Value.	1899. Quantity.	1899. 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	6,500,000	1,716,000	8
3,061	142,300	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	....	15,296,813	....	20,074,873	16
60,475,516	40,874,072	55,364,233	44,193,359	57,070,850	64,603,904	17
....	8,000,000	....	9,000,000	....	11,250,000	18
10,989,463	8,178,283	12,111,208	9,859,501	15,520,445	12,889,142	19
....	36,791,772	....	39,245,264	....	48,785,875	20
2,165	106,574	4,064	275,064	4,900	150,600	21
7,500	22,500	8,312	23,990	13,600	39,000	22
2,554	80,853	2,967	86,850	2,765	98,325	23
....	368,058	....	489,769	....	675,586	24
3,833	22,835	2,733	16,691	4,334	37,032	25
....	25,932	....	25,934	....	28,115	26
....	149,970	....	180,486	....	208,283	27
16,000,000	1,080,000	16,000,000	1,120,000	40,714,000	1,139,882	28
487,149	129,094	486,979	126,614	433,004	108,251	29
5,062	37,159	7,675	63,050	15,900	96,650	30
288,982	755,864	291,638	755,280	486,235	1,287,080	31
60,000	30,000	60,000	30,000	60,000	30,000	32
1,039,345	2,673,202	1,308,885	3,453,460	1,515,702	5,084,076	33
143,201	391,541	193,364	593,801	174,734	543,249	34
15,973,202	4,920,020	17,612,634	6,212,554	19,708,614	6,867,467	35
2,275	45,590	1,200	32,960	4,830	107,500	36
26,042	58,295	31,306	108,339	41,894	139,528	37
19,520	31,232	6,247	9,371	10,230	18,512	38
60,913	795,793	58,850	695,856	63,111	728,389	39
25,000	1,750,000	33,000	2,310,000	40,146	3,211,680	40
580	6,450	605	10,300	681	11,740	41
75,945	664,632	76,337	675,649	75,085	553,904	42
20,590	57,652	25,149	75,437	35,280	125,598	43
....	....	....	....	....	....	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
1,361,706	65,730	2,360,000	75,200	2,900,732	167,106	50
1,070		890		2,324		51
1,143	13,671	1,263	19,075	1,280	18,480	52
11,108	95,505	15,957	129,185	9,935	82,278	53
82,676	80,774	129,520	103,534	108,570	70,587	54
740	14,452	3,999	27,564	1,505	50,878	55
23,255,911	4,599,106	28,853,464	8,051,833	39,562,136	6,948,030	56
44,000	1,980	250,776	13,542	350,000	20,000	57
....	....	....	....	....	....	58
....	130,675	....	160,920	....	185,770	59
158	....	600	13,200	400	10,000	60
100	350	140	700	230	1,030	61
21,923	365,629	22,231	287,112	24,765	330,805	62
....	327,695,828	....	353,849,268	....	445,428,451	63
....	302,531,147	....	343,748,268	....	525,779,557	64
....	1,000,000	....	1,000,000	....	1,000,000	65
....	631,226,975	....	698,597,536	....	972,208,008	66

Mineral products of the United States for

	Product.		1900.	
			Quantity.	Value.
	METALLIC.			
1	Pig iron, value at Philadelphia	long tons	13,789,242	$259,944,000
2	Silver, coining value	troy ounces	57,647,000	74,533,495
3	Gold, coining value	do	3,829,897	79,171,000
4	Copper, value at New York City	pounds	606,117,166	98,494,039
5	Lead, value at New York City	short tons	270,824	23,561,688
6	Zinc, value at New York City	do	123,886	10,654,196
7	Quicksilver, value at San Francisco	flasks	28,317	1,302,586
8	Aluminum, value at Pittsburg	pounds	7,150,000	1,920,000
9	Antimony, value at San Francisco	short tons	4,226	837,896
10	Nickel, value at Philadelphia	pounds	9,715	3,886
11	Tin	do	....	....
12	Platinum, value (crude) at San Francisco	troy ounces	400	2,500
13	Total value of metallic products		....	550,425,286
	NONMETALLIC (SPOT VALUES).			
14	Bituminous coal	short tons	212,316,112	220,930,313
15	Pennsylvania anthracite	long tons	51,221,353	85,757,851
16	Natural gas		....	23,698,674
17	Petroleum	barrels	63,620,529	75,989,313
18	Brick clay		....	12,000,000
19	Cement	barrels	17,231,150	13,283,581
20	Stone		....	48,008,739
21	Corundum and emery	short tons	4,305	102,715
22	Crystalline quartz	do	14,461	40,705
23	Garnet for abrasive purposes	do	3,185	123,475
24	Grindstones		....	710,026
25	Infusorial earth and tripoli	short tons	3,615	24,207
26	Millstones		....	32,858
27	Oilstones, etc		....	174,087
28	Arsenious oxide	short tons	....	....
29	Borax	do	[b]1,602 [c]24,235	170,036 848,215
30	Bromine	pounds	521,444	140,790
31	Fluorspar	short tons	18,450	94,500
32	Gypsum	do	594,462	1,627,203
33	Lithium	do	520	....
34	Marls	do	60,000	30,000
35	Phosphate rock	long tons	1,491,216	5,359,248
36	Pyrite	do	204,615	749,991
37	Sulphur	short tons	3,525	88,100
38	Salt	barrels	20,869,342	6,944,603
39	Barytes (crude)	short tons	67,680	188,089
40	Cobalt oxide	pounds	6,471	11,648
41	Mineral paints	short tons	72,222	881,363
42	Zinc white	do	48,840	3,667,210
43	Asbestos	do	1,054	16,310
44	Asphaltum	do	54,389	415,958
45	Bauxite	long tons	23,184	89,676
46	Chromic iron ore	do	140	1,400
47	Clay (all other than brick)	short tons	1,221,660	1,840,377
48	Feldspar	do	24,821	180,971
49	Fibrous talc	do	63,500	499,500
50	Flint	do	32,495	86,351
51	Fuller's earth	do	9,698	67,535
52	Glass sand	do	....	....
53	Graphite (crystalline)	pounds	5,507,855	197,579
54	Graphite (amorphous)	short tons	611	
55	Magnesite	do	2,252	19,333
56	Manganese ore	long tons	11,771	100,289
57	Mica (sheet)	pounds	456,283	92,758
58	Mica (scrap)	short tons	5,497	55,202
59	Mineral waters	gallons sold	47,558,784	6,245,172
60	Monazite	pounds	908,000	48,805
61	Zircon	do	....	....
62	Precious stones		....	233,170
63	Pumice stone	short tons	....	....
64	Rutile	pounds	300	1,300
65	Talc and soapstone	short tons	27,943	383,541
66	Uranium and vanadium	do	....	....
67	Total value of nonmetallic mineral products		....	512,252,767
68	Total value of metallic products		....	550,425,286
69	Estimated value of mineral products unspecified		....	1,000,000
70	Grand total		....	1,063,678,053

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

the calendar years 1880-1904—Continued.

1901. Quantity.	1901. Value.	1902. Quantity.	1902. Value.	1903. Quantity.	1903. Value.	
15,878,354	$242,174,000	17,821,307	$372,775,000	18,009,252	$344,350,000	1
55,214,000	71,387,800	55,500,000	71,757,575	54,300,000	70,206,060	2
3,805,500	78,666,700	3,870,000	80,000,000	3,560,000	73,591,700	3
602,072,519	87,300,515	659,508,644	76,568,954	698,044,517	91,506,006	4
270,700	23,280,200	270,000	22,140,000	282,000	23,520,000	5
140,822	11,265,760	156,927	14,625,596	159,219	16,717,995	6
29,727	1,382,305	34,291	1,467,848	35,620	1,544,934	7
7,150,000	2,238,000	7,300,000	2,284,590	7,500,000	2,284,900	8
2,639	539,902	3,561	634,506	3,128	548,433	9
6,700	3,551	5,748	2,701	114,200	45,900	10
....	....	....	....	([a])	....	11
1,408	27,526	94	1,814	110	2,080	12
....	518,266,259	....	642,258,584	....	624,318,008	13
225,828,149	236,422,049	260,216,844	290,858,483	282,749,348	351,687,933	14
60,242,560	112,504,020	36,940,710	76,173,586	66,613,454	152,036,448	15
....	27,066,077	....	30,867,863	....	35,807,860	16
69,389,194	66,417,335	88,766,916	71,178,910	100,461,337	94,694,050	17
....	13,800,000	....	15,000,000	....	15,000,000	18
20,068,737	15,786,789	25,753,504	25,366,380	29,899,140	31,931,341	19
....	60,275,762	....	69,830,351	....	72,945,908	20
4,305	146,040	4,251	104,605	2,542	64,102	21
14,050	41,500	15,104	84,335	8,938	76,908	22
4,444	158,100	3,926	132,820	3,950	132,500	23
....	580,703	....	667,431	....	721,446	24
4,020	52,950	5,665	53,244	9,219	76,273	25
....	57,179	....	59,808	....	52,552	26
....	158,300	....	221,762	....	366,857	27
300	18,000	1,353	81,180	611	36,691	28
[b] 5,344	697,307	17,404	2,447,614	[c] 34,430	661,400	29
[c] 17,887	314,811	2,600	91,000			
552,043	154,572	513,893	128,472	598,500	167,580	30
19,586	113,803	48,018	271,832	42,523	213,617	31
633,791	1,506,641	816,478	2,089,341	1,041,704	3,792,943	32
1,750	43,200	1,245	25,750	1,155	23,425	33
99,880	124,880	12,439	12,741	34,211	22,521	34
1,483,723	5,316,403	1,490,314	4,693,444	1,581,576	5,319,294	35
241,691	1,257,879	207,874	947,089	[d] 233,127	1,109,818	36
([d])	([d])	([d])	([d])			37
20,566,661	6,617,449	23,849,231	5,668,636	18,968,089	5,286,988	38
49,070	157,844	61,668	203,154	50,397	152,150	39
13,360	24,048	3,730	6,714	120,000	228,000	40
61,460	789,962	73,049	944,332	63,687	635,557	41
46,500	3,720,000	52,645	4,016,499	62,962	4,801,718	42
747	13,498	1,005	16,200	887	16,760	43
63,134	555,335	105,458	765,048	101,255	1,005,446	44
18,905	79,914	27,322	120,366	48,087	171,306	45
368	5,790	315	4,567	150	2,250	46
1,367,170	2,576,932	1,455,357	2,061,072	1,641,835	2,594,042	47
34,741	220,422	45,287	250,424	41,891	256,733	48
69,200	483,600	71,100	615,350	60,230	421,600	49
34,420	149,297	36,365	144,209	55,233	156,947	50
14,112	96,835	11,492	98,144	20,693	190,277	51
....	....	943,135	807,797	823,044	855,828	52
3,967,612	167,714	3,936,824	182,108	4,538,155	225,554	53
809		4,739		16,591		54
3,500	10,500	2,830	8,490	3,744	10,595	55
11,995	116,722	7,477	60,911	2,825	25,335	56
360,060	98,859	373,266	83,843	619,600	118,088	57
2,171	19,719	1,400	35,006	1,659	25,040	58
55,771,188	7,586,962	64,859,451	8,793,761	51,242,757	9,041,078	59
748,736	59,262	802,000	64,160	862,000	64,630	60
....	....	....	....	3,000	570	61
....	289,050	....	328,450	....	307,900	62
....	....	700	2,750	885	2,665	63
44,250	5,710	([e])	....	....	....	64
28,643	424,888	26,854	525,157	[e] 26,671	418,460	65
375	....	3,810	48,125	30	5,625	66
....	567,284,612	....	617,243,314	....	793,962,609	67
....	518,266,259	....	642,258,584	....	624,318,008	68
....	1,000,000	....	1,000,000	....	1,000,000	69
....	1,086,550,871	....	1,260,501,898	....	1,419,280,617	70

[b] Refined. [c] Crude. [d] Included under pyrite. [e] Included under estimated unspecified products.

Mineral products of the United States for the calendar years 1880–1904—Continued.

Product.	1904. Quantity.	1904. Value.
METALLIC.		
Pig iron (spot value) ....long tons..	16,497,033	$233,025,000
Silver, coining value........troy ounces..	55,999,864	72,402,224
Gold, coining value........do....	3,910,729	80,835,648
Copper, value at New York City........pounds..	812,537,267	105,629,845
Lead, value at New York City........short tons..	307,000	26,402,000
Zinc, value at New York City........do....	186,702	18,670,200
Quicksilver, value at San Francisco........[a] flasks..	34,570	1,503,795
Aluminum, value at Pittsburg........pounds..	[b] 8,600,000	[b] 2,477,000
Antimony, value at San Francisco........short tons..	3,057	505,524
Nickel, value at Philadelphia........pounds..	24,000	11,400
Tin........do....	(c)	....
Platinum, value (crude) at San Francisco........troy ounces..	200	4,160
Total value of metallic products........	....	541,466,796
NONMETALLIC (spot values).		
Bituminous coal........short tons..	279,153,718	305,842,268
Pennsylvania anthracite........long tons..	65,318,490	138,974,020
Natural gas........	....	38,496,760
Petroleum........barrels..	117,063,421	101,170,466
Brick clay........	....	13,000,000
Cement........barrels.	31,675,257	26,031,920
Stone........	....	74,200,361
Corundum and emery........short tons..	1,932	57,235
Crystalline quartz........do....	31,924	74,600
Garnet for abrasive purposes........do....	3,854	117,581
Grindstones........	....	881,527
Infusorial earth and tripoli........short tons..	6,274	44,164
Millstones........	....	37,338
Oilstones, etc........	....	188,985
Arsenious oxide........short tons..	36	2,185
Borax (crude)........do....	45,647	698,810
Bromine........do....	897,100	269,130
Fluorspar........do....	36,452	234,755
Gypsum........do....	940,917	2,784,325
Lithium minerals........do....	577	5,155
Marls........do....	18,989	13,145
Phosphate rock........long tons..	1,874,428	6,873,625
Pyrite... } Sulphur[d] } ....do....	333,542	3,460,863
Salt........barrels..	22,030,002	6,021,222
Barytes (crude)........short tons..	65,727	174,958
Cobalt oxide........pounds..	22,000	42,600
Mineral paints........short tons..	59,785	631,171
Zinc white........do....	63,363	4,808,482
Asbestos........do....	1,480	25,740
Asphaltum........do....	81,572	903,741
Bauxite........long tons..	47,661	235,704
Chromic iron ore........do....	123	1,845
Clay (all other than brick)........short tons..	1,508,752	2,320,162
Feldspar........do....	45,188	266,326
Fibrous talc........do....	64,005	507,400
Flint........do....	52,270	100,590
Fuller's earth........do....	29,480	168,500
Glass sand........do....	858,719	796,492
Graphite { Crystalline........pounds..	5,681,177	} 341,372
Graphite { Amorphous........short tons..	19,115	}
Magnesite........do....	2,850	9,298
Manganese ore........long tons..	3,146	29,466
Mica { Sheet........pounds..	668,358	109,462
Mica { Scrap........short tons..	1,096	10,854
Mineral waters........gallons sold..	67,718,500	10,398,450
Monazite........pounds.. } Zircon........do.... }	745,999	85,038
Precious stones........	....	324,300
Pumice stone........short tons..	1,530	5,421
Rutile........pounds..	....	7,000
Sand, molding, building, etc........short tons..	....	4,951,607
Talc and soapstone........do....	27,184	433,331
Uranium and vanadium........do....	45	10,600
Total value of nonmetallic mineral products........	....	747,180,350
Total value of metallic products........	....	541,466,796
Estimated value of mineral products unspecified........	....	400,000
Grand total........	....	1,289,047,146

[a] Of 76½ avoirdupois pounds net; of 75 avoirdupois pounds net after June, 1904.
[b] Consumption in 1904.
[c] About 159 short tons of concentrates from South Carolina, South Dakota, and Alaska shipped to England in 1904.
[d] Included under pyrite since 1901.

IRON ORES.

By John Birkinbine.

PRODUCTION.

The active iron-ore mines in 25 States and Territories produced in the year ending December 31, 1904, 27,644,330 long tons of iron ore. Compared with the output for 1903 (35,019,308 tons) this was a decrease of 7,374,978 tons, or 21 per cent. Considered independently of other conditions, this suggests an unsatisfactory status, but the year 1902 witnessed the maximum production of the iron-ore mines of the United States, and the increased output of 1902 over that of 1900 approximated the decrease of the record of 1904 from that of 1903.

From 1895 to 1902 the iron-ore production of the United States showed annual increases every year, reaching a maximum of 35,554,135 long tons in 1902. The years 1902 and 1903 represented phenomenal outputs.

The following table shows the apparent consumption of iron ore in the United States for all purposes from 1889 to 1904, inclusive, exports also being included from 1899 to 1904:

Apparent consumption of iron ore for all purposes, 1889–1894.

Year.	Domestic iron ore produced.	Stocks of ore at mines.	Imports.	Exports.	Stocks of ore at lower lake ports, Dec. 1.	Zinc residuum.	Apparent consumption.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
1889	14,518,041	2,256,973	853,573		2,607,106	43,648	14,366,562
1890	16,036,043	[a]2,000,000	1,246,830		3,893,487	48,560	16,302,025
1891	14,591,178	2,450,279	912,864		3,508,489	38,228	15,476,989
1892	16,296,666	2,911,740	806,585		4,149,451	31,859	16,032,687
1893	11,587,629	3,526,161	526,951		4,070,710	37,512	11,616,412
1894	11,879,679	3,236,198	167,307		4,834,247	26,981	11,600,393
1895	15,957,614	2,976,494	524,153		4,415,712	43,249	17,203,255
1896	16,005,449	3,405,302	682,806		4,954,984	44,953	15,765,128
1897	17,518,046	3,098,287	489,970		5,923,755	33,924	17,380,184
1898	19,433,716	2,846,457	187,208		5,136,407	48,502	20,708,604
1899	24,683,173	2,320,278	674,082	40,665	5,530,283	65,010	25,513,903
1900	27,553,161	3,709,950	897,831	51,460	5,904,670	87,110	26,722,583
1901	28,887,479	4,239,823	966,950	64,703	5,859,663	52,311	29,357,171
1902	35,554,135	3,834,717	1,165,470	88,445	7,074,254	65,246	35,886,921
1903	35,019,308	6,297,888	980,440	80,611	6,371,085	73,264	34,232,399
1904	27,644,330	4,666,931	487,613	213,865	5,763,399	68,189	30,224,910

a No statistics collected.

The bulk of the domestic iron ore is smelted in blast furnaces to produce pig iron, but a considerable portion of such consumption does not occur in the year in which the ore is mined. The reserve stocks of ore at the opening and closing of the year at blast furnaces or at ports which receive the bulk of the iron ore mined or at the mines, together with the imports and exports of iron ore and other materials used as iron ore, should be considered in forming comparisons of annual records.

The following pages show that during the year 1904 the stocks of iron ore at the mines decreased 1,630,957 tons; that there were imported into the United States 487,613 long tons of iron ore and exported therefrom 213,865 long tons; that 68,189 long tons of zinc residuum were produced, and that the stocks of iron ore held at lower lake ports decreased 607,686 long tons. The apparent consumption of iron ore in 1904, therefore, approximates 30,224,910 long tons.

Using similar factors, the table of apparent consumption was prepared to show the apparent available supply of ore and, in connection with the next table, the relation this supply bore to the production of pig iron. There are, however, wanting other items necessary to form a correct comparison. Among these are the stocks of ore on hand at blast furnaces. On May 1, 1904, it was stated that the reserves of Lake Superior ores alone at blast furnaces amounted to about 7,000,000 tons; but these stocks are constantly varying, as are the mill cinder, scrap, roll scale, and other materials charged into the blast furnaces (amounting in the census year 1900 to 1,600,313 long tons), the quantity of iron ore used in open-hearth furnaces, as a fix in puddling and in other furnaces, as a flux in the silver smelters, in the manufacture of paint, etc.

In the preceding table the apparent consumption shows less variation than the reported production, and more truly represents the conditions prevailing in the iron-ore trade, while the reported production shows the mining activity in each year.

The following table indicates the quantities of domestic iron ore mined and of pig iron[a] produced in the United States for sixteen years:

[a] See statistics of the American Iron and Steel Association.

Production of iron ore and pig iron in the United States, 1889–1904.

Year.	Iron ore mined.	Pig iron produced.
	Long tons.	*Long tons.*
1889	14,518,041	7,603,642
1890	16,036,043	9,202,703
1891	14,591,178	8,279,870
1892	16,296,666	9,157,000
1893	11,587,629	7,124,502
1894	11,879,679	6,657,388
1895	15,957,614	9,446,308
1896	16,005,449	8,623,127
1897	17,518,046	9,652,680
1898	19,433,716	11,773,934
1899	24,683,173	13,620,703
1900	27,553,161	13,789,242
1901	28,887,479	15,878,354
1902	35,554,135	17,821,307
1903	35,019,308	18,009,252
1904	27,644,330	16,497,033

PRODUCTION BY VARIETIES OF ORE.

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

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

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.

The quantity of red hematite mined in the year 1904 was 23,839,477 long tons, or 86 per cent of the total for the United States, a decrease of 6,489,177 long tons, or 21 per cent, from the 1903 production of 30,328,654 long tons. Over one-half of the total production of red hematite was obtained from Minnesota, approximately one-third from Michigan, with Alabama, Wisconsin, and Tennessee following in order of rank. The output of brown hematite in 1904 was 2,146,795 long tons, a decrease of 933,604 long tons, or 30 per cent, from the 1903 total of 3,080,399 long tons. As in the previous year Alabama was the principal contributor, followed by Virginia and West Virginia, and Georgia.

The magnetite class has shown an increase in 1904, rising to 1,638,846 long tons, or 63,424 tons more than in 1903, when 1,575,422 long tons were produced. This is due principally to the increased activity in the Lake Champlain district of New York, which State headed the list for this class of ore, followed by New Jersey and Pennsylvania.

The 1903 output of 34,833 tons of carbonate ore showed a still further decline to 19,212 tons in 1904.

The following table presents the production of iron ore by classes in the different States, except where these have been combined to preserve the confidential character of the report:

Production of iron ore in the United States in 1904, by States and varieties.

State.	Red hematite.	Brown hematite.	Magnetite.	Carbonate.	Total.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Minnesota	12,728,835				12,728,835
Michigan	7,089,887				7,089,887
Alabama	2,894,423	787,514	17,944		3,699,881
New York	53,329		788,974		842,303
Virginia and West Virginia	17,952	528,853	3,448		550,253
Tennessee	309,419	191,563			500,982
New Jersey			499,949		499,949
Wisconsin	467,475	16,000			483,475
Pennsylvania	5,286	164,206	227,615		397,107
Georgia	55,206	238,596			293,802
Montana, Nevada, New Mexico, Texas, Utah, and Wyoming	154,828	17,198	38,919		210,945
Colorado	1,446	149,526			150,972
North Carolina		2,350	61,997		64,347
Missouri	26,391	22,894			49,285
Kentucky	35,000				35,000
Connecticut and Massachusetts		21,990			21,990
Ohio				15,672	15,672
Maryland		6,105		3,540	9,645
Total	23,839,477	2,146,795	1,638,846	19,212	27,644,330

[NOTE.—In addition, there were obtained from an old manganese dump in Arkansas 600 tons of ore carrying 28 per cent manganese and 10 to 14 per cent of iron, which was used in manufacturing a special grade of iron and is not included in this total.]

The statistics of the different varieties of iron ore were first collected by the United States Geological Survey in the year 1889, and a summary of the quantities mined annually since that date indicates the pronounced advance in the amount of red hematite won, the moderate increase in quantity of brown hematite, which, however, shows a decline in the approximate percentage; also the falling off in the production of magnetite and of carbonate ore. The total of each class for the last sixteen years and the percentage of each class are given in the table following.

Production of iron ores in the United States, by varieties, 1889–1904.

[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
1904	23,839,477	2,146,795	1,638,846	19,212	27,644,330
Total	265,251,289	39,478,182	26,427,821	2,008,355	333,165,647
Percentages of totals for 16 years	80	12	7	1	....
Percentages of total for 1904	86	8	6	....	....

The production of concentrated ore in the United States in the year 1904 was 370,118 long tons, most of which was magnetically separated. There were also made 68,189 tons of residuum, a by-product from smelting zinc ores which were available for use in the manufacture of spiegeleisen.

Other materials fed to blast furnaces because of the metallic iron which can be obtained from them are blue billy (purple ore) resulting from the roasting of pyrites, scrap, roll scale, rolling-mill cinder, etc.; of these no exact statistics are collected.

LAKE SUPERIOR REGION.

The most prominent iron-ore producing district in the world comprises the five ranges located near the shores of Lake Superior, in the States of Minnesota, Michigan, and Wisconsin, the bulk of the iron ore mined being brought to the shipping ports on Lakes Superior and Michigan to be forwarded to consuming centers in Pennsylvania, Ohio, Illinois, New York, West Virginia, Virginia, etc.

Ore was first produced in the State of Michigan in the year 1854 on the Marquette Range, and then in turn on the Menominee Range in 1872 and on the Gogebic Range in 1884; the latter two also extend into the State of Wisconsin, but the more important producing mines are in Michigan.

In Minnesota the ore is obtained from the Vermilion Range, which made its initial shipment in 1884. and from the Mesabi Range, which, although only opened in 1892, has risen to first rank as a producer of iron ore, contributing in late years practically one-half of the total for the Lake Superior region.

In the year 1900 the Michipicoten Range was opened in the Province of Ontario in Canada, but its production is comparatively small, the quantity mined in the year 1904 being 95,887 tons, and the total output since its opening 911,039 tons.

In the following statistics of the Lake Superior region the data given relate only to the United States, the Michipicoten Range being omitted. The total production of the Lake Superior region in the year 1904 was 20,198,311 long tons, a decrease from the 1903 total (26,573,271 tons) of 6,374,960 tons, or 24 per cent. Of this production the Mesabi Range contributed 11,672,405 long tons, or 57.8 per cent, the Menominee Range 2,871,130 tons, or 14.2 per cent, the Marquette Range 2,465,448 tons, or 12.2 per cent, the Gogebic Range 2,132,898 tons, or 10.6 per cent, and the Vermilion Range 1,056,430 tons, or 5.2 per cent.

The figures of reported shipments from these ranges in 1904 are in excess of those given as production, due to the stocks of iron ore already on hand at the mines being drawn upon.

The following table presents the production of the Lake Superior region by ranges from 1889 to 1904, inclusive:

Production of Lake Superior iron ores, by ranges, 1889–1904.

[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	2,275,664
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

Production of Lake Superior iron ores, by ranges, 1889–1904—Continued.

Range.	1899.	1900.	1901.	1902.	1903.	1904.
	Long tons.	*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	2,465,448
Menominee	3,281,422	3,680,738	3,697,408	*4,421,250*	4,093,320	2,871,130
Gogebic	2,725,648	3,104,033	3,041,869	*3,683,792*	3,422,341	2,132,898
Vermilion	1,643,984	1,675,949	1,805,996	*2,057,532*	1,918,584	1,056,430
Mesabi	6,517,305	8,158,450	9,303,541	13,080,118	*13,452,812*	11,672,405
Total	17,802,955	20,564,238	21,445,903	*26,977,404*	26,573,271	20,198,311

A falling off in 1904 in the production of all the ranges will be noted.

The most recently developed range, the Mesabi, took first place in the year 1895 and has since occupied this position. Its total shipments from its opening in 1892 to the close of 1904, thirteen years, exceed those of the Marquette Range from its initial operation in 1854 to the end of 1904, fifty-one years, and represent nearly 30 per cent of the total output of the entire Lake Superior region to date.

The Marquette Range, the pioneer, was the prominent producer, with the exception of the years 1890 and 1892, from the time of its opening to the year 1895; since that date it has occupied either second or third position.

The Menominee Range has never been first, but has ranked in late years either second or third.

The Gogebic Range was the principal producer in the years 1890 and 1892, second or third until 1898, and fourth since that date.

The Vermilion Range has always ranked last with the exception of the years 1892 and 1893, when it was fourth.

All of the ores shipped from the Lake Superior region are high in iron content, except some siliceous low phosphorus ores, which are valuable for mixtures, as will be seen from the cargo analyses of iron ores as shipped in 1904 furnished by the courtesy of the Lake Superior Iron Ore Association.

Complete average cargo analyses of Lake Superior iron ores of season 1904.

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

GOGEBIC RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Ashland	59.90	0.045	7.10	0.340	3.03	0.430	0.270	0.010	2.85	....
	53.49	.040	6.34	.304	2.70	.384	.241	.0089	2.54	10.70
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	13.668
Asteroid	52.94	.075	....	....	....	....	....	....	....	....
	45.22	.064	....	....	....	....	....	....	....	14.58
Atlantic	63.9713	.0389	....	....	....	....	....	....	....	....
	57.3020	.03484	....	....	....	....	....	....	....	10.4249
Aurora	61.9596	.0344	....	....	....	....	....	....	....	....
	54.9380	.03050	....	....	....	....	....	....	....	11.3337
Best[a]	56.00	.054	12.32	.90	1.219	.32	.45	.011	3.25	....
	49.72	.0479	10.939	.799	1.082	.28	.40	.0098	2.886	11.21
Bonnie	49.38	.035	13.47	6.72	1.53	.04	.10	.023	4.86	....
	44.36	.031	12.10	6.037	1.37	.036	.09	.0207	4.366	10.16
Brotherton[a]	62.17	.027	8.30	.33	.899	.21	.21	.003	.80	....
	56.6741	.02461	7.5662	.3008	.8195	.1914	.1914	.0027	.7292	8.84
Cary[a]	60.07	.078	6.95	.41	1.01	.20	.13	.006	4.92	....
	54.3213	.07054	6.2849	.3708	.9133	.1809	.1176	.0054	4.4492	9.57
Cary Empire	58.41	.059	6.19	2.52	.88	.19	.29	.006	5.31	....
	52.4755	.05301	5.5611	2.2640	.7906	.1707	.2605	.0054	4.7705	[a]10.16
Comet	54.50	.052	....	....	....	....	....	....	....	....
	46.53	.044	....	....	....	....	....	....	....	14.62
Hildreth[a]	54.63	.080	13.91	.59	2.45	.39	.46	.009	3.71	....
	47.5281	.06960	12.1017	.5133	2.1315	.3393	.4002	.0078	3.2277	13.00
Jack Pot	60.11	.039	7.62	....	....	....	....	....	....	....
	53.9487	.03500	6.8389	....	....	....	....	....	....	10.25
Lawrence	62.14	.055	4.55	.61	1.59	.10	.08	.013	3.50	....
	55.78	.049	4.08	.55	1.43	.09	.07	.012	3.14	10.23
Lyon	58.00	.055	12.00	....	....	....	....	....	....	....
	51.28	.0486	10.609	....	....	....	....	....	....	11.59
Melrose	61.287	.0435	6.65	.70	1.25	.15	.10	.014	4.30	....
	54.178	.038	5.879	.619	1.105	.13	.088	.012	3.80	11.60
Mikado[a]	58.00	.157	12.40	.40	1.03	.59	.12	.009	1.76	....
	51.0400	.13816	10.9120	.3520	.9064	.5192	.1056	.0079	1.5488	12.00
Montreal	63.45	.042	3.90	.34	1.21	.22	.20	.009	3.55	....
	57.35	.038	3.52	.31	1.09	.20	.18	.008	3.21	9.62
Montrose	59.93	.063	8.04	.43	1.12	.30	.25	.010	3.96	....
	54.669	.057	7.33	.392	1.02	.27	.228	.009	3.61	8.778
New Era[a]	57.50	.045	10.68	.64	1.92	.20	.18	.009	3.21	....
	52.078	.0408	9.67	.58	1.739	.18	.16	.008	2.907	9.43
New Era No. 2	57.18	.064	12.19	.47	1.02	.20	.16	.017	3.95	....
	51.868	.058	11.058	.426	.925	.18	.145	.015	3.58	9.29
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	62.2503	.0751	....	....	....	....	....	....	....	....
	54.5570	.06581	....	....	....	....	....	....	....	12.3625
Norrie	62.7652	.03735	....	....	....	....	....	....	....	....
	55.7954	.03320	....	....	....	....	....	....	....	11.1052

[a] Expected analysis for the season of 1905.

Complete average cargo analyses of Lake Superior iron ores of season 1904—Continued.

GOGEBIC RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Ottawa [a]	58.60	0.059	5.18	2.40	1.37	0.20	0.25	0.013	5.29	....
	53.18	.054	4.70	2.18	1.24	.18	.23	.012	4.80	9.25
Ottawa Manganese	55.48	.070	6.41	4.56	1.47	.15	.11	.006	5.97	....
	50.44	.064	5.83	4.15	1.34	.14	.10	.005	5.43	9.09
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	61.4045	.0469	....	....	....	....	....	....	....	....
	54.1806	.04138	....	....	....	....	....	....	....	11.7626
Rowe [a]	58.209	.0459	10.80	.72	1.29	.23	.18	.014	3.10	....
	50.99	.040	9.46	.63	1.13	.20	.158	.012	2.716	12.40
Sunday Lake [a]	62.26	.026	8.18	.43	1.13	.07	.27	.006	.99	....
	56.8994	.02376	7.4757	.3929	1.0327	.0639	.2467	.0054	.9047	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	63.1738	.05225	....	....	....	....	....	....	....	....
	55.4974	.04590	....	....	....	....	....	....	....	12.1478
Wisconsin	48.71	.056	11.28	7.78	2.23	.11	.12	.006	5.34	....
	43.3519	.04984	10.0392	6.9242	1.9847	.0979	.1068	.00534	4.7526	[a]11.00
Windsor Bessemer [a]	61.00	.056	5.29	.60	.88	.19	.29	.006	5.31	....
	54.9000	.0504	4.7610	.5400	.7920	.1710	.2610	.0054	4.7790	10.00
Yale	62.92	.036	5.13	.36	.85	.46	.31	.019	2.64	....
	55.89	.032	4.56	.32	.75	.41	.28	.017	2.34	11.18

BARABOO RANGE.

Illinois	54.27	0.052	17.42	0.21	1.52	0.41	0.20	....	2.02	....
	48.01	.045	15.41	.19	1.34	.36	.18	....	1.78	11.54

MARQUETTE RANGE.

Abbotsford	61.8758	0.036	....	....	....	....	....	....	....	....
	61.0067	.03585	....	....	....	....	....	....	....	1.4093
Alford	63.3405	.05005	....	....	....	....	....	....	....	....
	56.4315	.04459	....	....	....	....	....	....	....	10.9054
Angeline, Hard	66.74	.014	2.09	....	....	....	....	....	....	....
	63.1560	.01324	1.9777	....	....	....	....	....	....	5.37
Angeline, Hematite	64.94	.045	3.44	....	....	....	....	....	....	....
	57.9394	.04014	3.0691	....	....	....	....	....	....	10.78
Angeline, South	64.08	.120	3.63	....	....	....	....	....	....	....
	57.8514	.10833	3.2771	....	....	....	....	....	....	9.72
Austin Bessemer [a]	64.70	.060	3.57	0.380	0.650	0.810	0.350	0.009	0.550	....
	55.00	.051	3.03	.323	.552	.688	.297	.0076	.467	15.00
Austin Non-Bessemer [a]	61.70	.370	5.27	.410	1.17	1.78	.480	.013	.700	....
	52.45	.314	4.48	.348	.994	1.51	.408	.011	.595	15.00
Bedford	59.5733	.13975	....	....	....	....	....	....	....	....
	53.0252	.12439	....	....	....	....	....	....	....	10.9847
Beresford Lump	63.1648	.11480	....	....	....	....	....	....	....	....
	62.5701	.11371	....	....	....	....	....	....	....	.9412

[a] Expected analysis for the season of 1905.

Complete average cargo analyses of Lake Superior iron ores of season 1904—Continued.

MARQUETTE RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Beresford No. 2	61.2326	0.11445								
	60.566	.11320								1.0885
Bernhart	60.2408	.07485								
	54.8431	.06814								8.961
Buffalo-Cameo	58.6349	.10145								
	51.0488	.08832								12.9408
Cambria[a]	60.00	.055								
	55.20	.0506								8.00
Cambridge	59.16	.685	5.68	0.51	1.08	2.25	0.63	0.012	1.90	
	51.2765	.5891	4.8853	.4386	.9289	1.9352	.5418	.0103	1.6341	13.99
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	12.00
Castleford	55.5994	.0866								
	55.0592	.08575								.9709
Castleford Bessemer	55.9262	.03855								
	55.0341	.03792								1.612
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	12.00
Chatford	50.82	.125								
	46.48	.11432								8.54
Cliffs shaft, crushed	63.00	.110	3.82	.240	1.98	.830	.660	.019	.350	
	62.46	.1091	3.79	.238	1.963	.823	.654	.0188	.347	.85
Cliffs shaft, lump	64.00	.102	3.05	.340	1.96	.700	.700	.018	.650	
	63.75	.1016	3.038	.3387	1.952	.697	.697	.0179	.6475	.38
Clinton	63.30	.294	4.50	.270	1.69	.870	.160	.011	1.00	
	55.39	.257	3.94	.236	1.48	.761	.140	.0096	.875	12.50
Empire[a]	45.00	.057	30.00	.112	1.14					
	44.10	.0558	29.40	.1097	1.117					2.00
Foxdale[a]	56.15	.076	18.61	.25	2.46	1.40	.60	.027		
	55.08	.075	18.26	.24	2.41	1.37	.59	.026		1.90
Imperial[a]	52.44	.256	13.49	.198	1.20	1.370	1.390	.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	60.00	.106	5.65	.580	2.67	.530	.640	.014	3.15	
	52.80	.093	4.97	.510	2.35	.466	.563	.0123	2.77	12.00
Lake Bessemer	63.20	.040	5.80	.280	1.49	.300	.110	.009	1.10	
	56.25	.0356	5.16	.249	1.32	.267	.098	.008	.979	11.00
Lake Bessemer Silica	47.70	.045	26.25	.340	.930	.320	.230	.009	3.00	
	42.83	.0404	23.57	.305	.835	.287	.2065	.008	2.694	10.20
Lillie[a]	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]	60.328	.100	5.98	.23	3.27	.56	1.18	.012	2.39	
	53.089	.088	5.26	.20	2.878	.49	1.038	.0106	2.10	12.00
Moore	38.8189	.03255								
	37.7136	.03161								2.8696
Negaunee Bessemer	59.70	.060	7.00	.300	2.67	.860	.160	.012	1.80	
	52.66	.0529	6.17	.265	2.35	.758	.141	.0105	1.59	11.80
Negaunee non-Bessemer	58.20	.135	7.70	.360	3.07	1.42	.160	.015	2.10	
	50.63	.117	6.70	.313	2.67	1.23	.139	.013	1.83	13.00

[a] Expected analysis for the season of 1905.

Complete average cargo analyses of Lake Superior iron ores of season 1904—Continued.

MARQUETTE RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Princeton No. 1 [a]	63.00	0.055	2.30	0.43	1.37	1.05	0.93	0.021	1.60	....
	52.7688	.04606	1.9264	.3601	1.1475	.8794	.7789	.0175	1.3401	16.24
Princeton No. 2	59.26	.147	5.68	.50	1.00	1.20	.61	.033	3.02	....
	50.3653	.1249	4.8268	.4249	.8498	1.0197	.5183	.0280	2.5663	15.02
Republic Crushed	62.25	.044	7.83	1.13	1.16	.52	.35	.006	.20	....
	61.81	.0437	7.775	1.12	1.15	.516	.348	.006	.199	.70
Republic Specular, Lump	67.70	.052	1.81	.055	.420	.49	.13	.053	None.	....
	67.30	.0517	1.799	.0547	.418	.487	.129	.0527	None.	.59
Richmond	43.695	.048	33.43	.35	.94	.21	.12	.005	1.88	....
	42.279	.046	32.347	.339	.91	.20	.116	.0048	1.819	3.24
Rose [a]	59.08	.146	6.41	.33	2.45	.50	.18	.029	2.16	....
	53.17	.131	5.769	.297	2.20	.45	.16	.026	1.94	10.00
Salisbury	60.60	.136	6.70	.360	2.50	.500	.500	.011	1.80	....
	52.96	.119	5.85	.315	2.18	.437	.437	.0096	1.57	12.60
Scotch [a]	61.70	.134	6.70	.120	2.60	.450	.560	.014	.350	....
	61.212	.1329	6.647	.119	2.579	.4464	.5555	.0138	.3472	.79
Sheffield	63.59	.030	5.88	....	....	....	....	....	....	....
	60.4994	.02854	5.5942	....	....	....	....	....	....	4.86
Tilden Silica [a]	41.50	.040	37.25	.270	.85	.430	.110	.009	1.17	....
	40.943	.0394	36.75	.2664	.838	.4242	.1085	.0088	1.154	1.34
Volunteer	55.418	.1025	....	....	....	....	....	....	....	....
	54.9545	.10164	....	....	....	....	....	....	....	.8366

MENOMINEE RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Ajax	55.5203	0.06395	....	....	....	....	....	....	....	....
	51.0249	.05981	....	....	....	....	....	....	....	6.4646
Baltic	58.15 [a]	.515	4.12 [a]	0.23	3.28	1.14	0.92	0.071	5.82	....
	53.4980	.47380	3.7904	.2116	3.0176	1.0488	.8464	.0653	5.3544	8.00
Barton	58.1073	.50345	....	....	....	....	....	....	....	....
	54.4902	.47210	....	....	....	....	....	....	....	6.2255
Beta [a]	58.00	.337	6.20	.12	.99	.28	.14	.009	8.49	....
	53.9400	.31341	5.7660	.1116	.9207	.2604	.1302	.0084	7.8957	7.00
Bristol	56.30	.671	4.36	1.06	2.26	2.42	1.06	.009	6.25	....
	51.44	.613	3.98	.97	2.06	2.21	.97	.008	5.71	8.63
Chapin	59.9498	.06385	....	....	....	....	....	....	....	....
	56.3089	.05997	....	....	....	....	....	....	....	6.0735
Clearfield	58.7416	.12875	....	....	....	....	....	....	....	....
	51.513	.11289	....	....	....	....	....	....	....	12.3173
Clifford	41.27	.014	37.90	.05	.94	.45	.51	.029	.55	....
	40.21	.014	36.92	.05	.92	.44	.50	.028	.54	2.58
Davidson [a]	58.27	.365	7.22	.10	1.72	1.29	1.28	.125	3.65	....
	52.44	.329	6.50	.09	1.55	1.16	1.15	.113	3.29	10.00
Florence	55.35	.313	6.10	.26	3.55	1.75	2.60	.100	5.30	....
	50.19	.2838	5.53	.236	3.219	1.587	2.358	.0907	4.806	9.32
Forest	60.2013	.0353	....	....	....	....	....	....	....	....
	55.8531	.03274	....	....	....	....	....	....	....	7.2284
Gamma [a]	50.10	.351	18.80	.07	.79	.20	.07	.013	7.50	....
	47.0940	.32994	17.6720	.0658	.7426	.1880	.0658	.0122	7.05	6.00
Granada	59.7086	.0617	....	....	....	....	....	....	....	....
	55.2991	.05714	....	....	....	....	....	....	....	7.3841

[a] Expected analysis for the season of 1905.

Complete average cargo analyses of Lake Superior iron ores of season 1904—Continued.

MENOMINEE RANGE—Continued.

Ore.	Iron	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Hemlock	55.28	0.210	5.98	0.32	3.06	3.54	2.92	0.010	4.41	....
	52.5160	.19950	5.6810	.3040	2.9070	3.3630	2.7740	.0095	4.1895	5.00
Iron Ridge	45.40	1.75	....	....	....	....	....	....	....	....
	....	....	....	....	....	....	....	....	....	....
Manganate	52.11	.684	5.60	3.01	2.57	1.96	1.60	.017	5.87	....
	47.72	.626	5.13	2.76	2.35	1.79	1.47	.016	5.38	8.42
Manganate No. 2	50.06	.550	4.90	5.06	2.87	1.70	1.30	.027	7.80	....
	47.10	.517	4.61	4.76	2.70	1.60	1.22	.025	7.34	5.91
Millie [a]	60.146	.023	3.82	.21	.79	1.91	1.87	.017	4.30	....
	56.826	.0217	3.609	.198	.716	1.80	1.767	.016	4.06	5.52
Pewabic	63.83	.009	4.95	.14	1.01	.41	1.22	.003	.92	....
	58.3534	.00823	4.5253	.1280	.9233	.3748	1.1153	.0027	.8411	8.58
Pewabic Genoa	41.48	.010	36.35	.07	1.21	.56	1.28	.008	1.16	....
	....	....	....	....	....	....	....	....	....	....
Russell [a]	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
Toledo	48.69	.007	26.06	.11	1.13	.53	1.22	.011	1.03	....
	45.2038	.00650	24.1941	.1021	1.0491	.4921	1.1326	.0102	.9563	7.16
Vivian	40.00 [a]	.015	36.67 [a]	.12	1.47	1.91	.98	.012	1.60	....
	38.6000	.01448	35.3866	.1158	1.4186	1.8432	.9457	.0116	1.5440	3.50
Walpole	59.40	.143	7.01	.15	1.51	1.43	2.26	.003	2.15	....
	54.4995	.13120	6.4317	.1376	1.3854	1.3120	2.0736	.0028	1.9726	8.25
Wancedah [a]	40.00	.018	37.30	.15	1.50	.60	1.20	.011	1.60	....
	38.4000	.01728	35.8080	.1440	1.4400	.5760	1.1520	.01056	1.5360	4.00
Youngs [a]	60.55	.322	3.80	.20	2.61	1.03	.80	.058	5.35	....
	55.7060	.29624	3.4960	.1840	2.4012	.9476	.7360	.0538	4.9220	8.00

MESABI RANGE.

Ore.	Iron	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Agnew	58.15	0.036	9.37	0.71	2.00	0.20	0.12	....	3.51	....
	50.90	.031	8.14	.61	1.75	.17	.11	....	3.07	12.46
Albany	58.89 [a]	.092	4.50 [a]	.84	2.48	.16	.11	0.009	7.19	....
	53.0010	.08280	4.0500	.7560	2.2320	.1440	.0990	.0081	6.4710	10.00 [a]
Athens	62.31	.045	3.48	.69	1.22	.15	.18	.006	4.82	....
	55.4995	.04008	3.0996	.6145	1.0866	.1336	.1603	.0053	4.2931	10.93
Atlas Malta	61.00	.070	7.34	.59	1.11	.29	.21	.010	2.86	....
	54.90	.06300	6.6060	.5310	.9990	.2610	.1890	.0090	2.5740	10.00
Beaver Mahoning	63.30	.086	2.67	.30	1.35	.18	.12	.011	4.80	....
	56.31	.0765	2.375	.267	1.20	.16	.107	.00979	4.27	11.04
Bessemer [a]	62.00	.035	....	....	....	....	....	....	....	....
	57.04	.032	....	....	....	....	....	....	....	8.00
Biwabik	62.39	.044	4.02	.49	1.33	.26	.11	.009	4.25	....
	56.9308	.04015	3.6682	.4471	1.2136	.2372	.1003	.0082	3.8781	8.75
Butler [a] (Biwabik)	62.00	.055	4.50	.49	1.20	.32	.08	.01	4.47	....
	57.0400	.05060	4.1400	.4508	1.1040	.2944	.0736	.0092	4.1124	8.00
Cass [a]	59.00	.040	8.73	.71	1.76	.29	.24	.004	3.95	....
	53.6900	.0364	7.9443	.6461	1.6016	.2639	.2184	.0036	3.5945	9.00
Clark-Chisholm	63.0389	.0394	....	....	....	....	....	....	....	....
	57.289	.03580	....	....	....	....	....	....	....	9.1216

[a] Expected analysis for the season of 1905.

Complete average cargo analyses of Lake Superior iron ores of season 1904—Continued.

MESABI RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Corsica [a]	57.70	.045	8.94	.75	.83	.16	.14	.008	6.31	....
	50.7760	.03960	7.8672	.6600	.7304	.1408	.1232	.0070	5.5528	12.00
Crosby [a]	58.00	.040	....	....	....	....	....	....	....	....
	51.91	.0358	....	....	....	....	....	....	....	10.50
Cyprus	61.15	.077	3.33	.54	1.33	.29	.14	.008	6.61	....
	53.8120	.06776	2.9304	.4752	1.1704	.2552	.1232	.0070	5.8168	12.00
Douglas	58.89	.031	10.65	....	....	....	....	....	....	....
	54.0727	.02846	9.7788	....	....	....	....	....	....	8.18
Duluth	60.71	.044	....	....	....	....	....	....	....	....
	54.49	.03949	....	....	....	....	....	....	....	10.24
Elba	61.83	.037	3.94	1.09	.94	.13	.07	.007	4.64	....
	56.5745	.03386	3.6051	.9974	.8601	.1190	.0641	.0064	4.2456	8.50
Forest	60.20	.030	6.53	.96	1.71	.30	.31	.007	3.42	....
	53.75	.0268	5.83	.857	1.527	.268	.277	.006	3.05	10.71
Grant	60.53	.078	5.18	....	....	....	....	....	....	....
	53.4964	.06893	4.5780	....	....	....	....	....	....	11.62
Group One	62.0094	.0363	....	....	....	....	....	....	....	....
	55.4988	.03248	....	....	....	....	....	....	....	10.501
Group Two	62.3278	.0432	....	....	....	....	....	....	....	....
	55.8247	.03868	....	....	....	....	....	....	....	10.4481
Group Three	59.4277	.06635	....	....	....	....	....	....	....	....
	50.9521	.05691	....	....	....	....	....	....	....	14.2619
Hawkins	57.51	.055	10.74	.21	2.55	.22	.11	....	3.82	....
	51.10	.049	9.54	.19	2.26	.19	.10	....	3.38	11.14
Higgins	61.024	.0222	....	....	....	....	....	....	....	....
	56.997	.02073	....	....	....	....	....	....	....	6.6006
Holland [a]	61.00	.040	5.27	.41	.92	.29	.11	.012	3.37	....
	54.9000	.03600	4.7430	.3690	.8280	.261	.099	.0108	3.0330	10.00
Juniata (Mountain Iron and Oliver)	61.0368	.0526	....	....	....	....	....	....	....	....
	53.0193	.04569	....	....	....	....	....	....	....	13.1358
Kinney [a]	58.50	.09	5.00	.75	2.50	.70	.40	....	....	....
	52.06	.08	4.45	.668	2.22	.62	.36	....	....	11.00
La Rue [a]	60.00	.045	7.15	.32	.958	.16	.03	.012	2.17	....
	55.20	.04140	6.5780	.2944	.8813	.1472	.0276	.011	1.996	8.00
Leetonia Bessemer [a]	61.47	.045	2.73	.65	.702	.10	.04	.004	6.93	....
	54.3394	.03978	2.4133	.5746	.6205	.0884	.0353	.0035	6.1261	11.60
Leetonia [a]	61.47	.061	2.73	.65	.702	.10	.04	.004	6.93	....
	54.3394	.05392	2.4133	.5746	.6205	.0884	.0353	.0035	6.1261	11.60
Leonard [a]	59.125	.080	3.38	.57	.84	.16	.10	.022	9.90	....
	53.00	.0717	3.03	.51	.75	.14	.09	.0197	8.87	10.36
Leonard-Republic	59.905	.046	6.01	.81	1.41	.235	.16	.012	5.53	....
	52.23	.040	5.24	.706	1.229	.205	.14	.01	4.82	12.81
Lincoln	60.55	.037	8.40	....	....	....	....	....	....	....
	55.6393	.03399	7.7187	....	....	....	....	....	....	8.11
Mahoning	65.35	.045	1.45	.21	1.08	.11	.08	.013	3.50	....
	58.98	.0406	1.309	.19	.97	.099	.07	.0117	3.159	9.745
Malta	63.00 [a]	.030	4.88 [a]	.76	.98	.20	.09	.010	2.67	....
	57.3300	.02730	4.4408	.6916	.8918	.1820	.0819	.0091	2.4927	9.00
Minorca	61.00 [a]	.032	6.22 [a]	.79	1.56	.22	.18	.008	3.26	....
	56.1200	.02944	5.7224	.7268	1.4352	.2024	.1656	.0074	2.9992	8.00
Morrow [a]	60.00	.061	6.72	.64	.139	.22	.16	.012	4.94	....
	54.60	.05551	6.1152	.5824	.12658	.202	.1456	.0109	4.4954	9.00

[a] Expected analysis for the season of 1905.

Complete average cargo analyses of Lake Superior iron ores of season 1904—Continued.

MESABI RANGE—Continued.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Pettit[a]	60.00	.047	....	....	....	....	....	....	....	....
	53.40	.0418	....	....	....	....	....	....	....	11.00
Shenango[a]	62.50	.040	....	....	....	....	....	....	....	....
	56.3750	.03608	....	....	....	....	....	....	....	9.80
Shilling[a] (Biwabik)	60.23	.061	4.80	.65	1.29	.21	.09	.008	5.56	....
	54.2070	.05490	4.3200	.5850	1.1610	.1890	.0810	.0072	5.0040	10.00
Sparta	61.28	.026	8.23	.52	.89	.17	.13	.010	2.25	....
	55.7648	.02366	7.4893	.4732	.8099	.1547	.1183	.0091	2.0475	9.00
Troy	54.82	.035	11.00	.89	2.17	.44	1.09	.141	5.35	....
	48.2416	.03080	9.6800	.7832	1.9096	.3872	.9592	.1241	4.7080	12.00[a]
Verona	40.98	.019	....	....	....	....	....	....	....	....
	39.5989	.01835	....	....	....	....	....	....	....	3.37
Webb[a]	58.00	.032	....	....	....	....	....	....	....	....
	52.2000	.02880	....	....	....	....	....	....	....	10.00
Wilpen[a]	59.50	.055	....	....	....	....	....	....	....	....
	53.2525	.04922	....	....	....	....	....	....	....	10.50

MICHIPICOTEN RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Helen	58.40	0.089	7.16	0.29	1.06	0.11	0.09	0.091	7.40	....
	55.188	0.084	6.766	.27	1.00	.10	.085	.086	6.99	5.50

VERMILION RANGE.

Ore.	Iron.	Phosphorus.	Silica.	Manganese.	Alumina.	Lime.	Magnesia.	Sulphur.	Loss by ignition.	Moisture.
Chandler	63.4728	0.0444	....	....	....	....	....	....	....	....
	59.9655	.04194	....	....	....	....	....	....	....	5.5256
Pioneer	62.8688	.0362	....	....	....	....	....	....	....	....
	59.6349	.03434	....	....	....	....	....	....	....	5.1374
Savoy	63.6839	.0448	....	....	....	....	....	....	....	....
	60.1619	.04232	....	....	....	....	....	....	....	5.5305
Soudan-Vermilion, lump	66.8471	.1298	....	....	....	....	....	....	....	....
	66.3373	.12881	....	....	....	....	....	....	....	.7626
Vermilion, crushed	67.1548	.135	....	....	....	....	....	....	....	....
	66.7635	.13421	....	....	....	....	....	....	....	.5827
Zenith	65.8097	.0388	....	....	....	....	....	....	....	....
	61.9754	.03653	....	....	....	....	....	....	....	5.8263

[a] Expected analysis for the season of 1905.

IRON-ORE INDUSTRY OF THE VARIOUS STATES IN 1904.

Minnesota.—All of the iron ore mined in 1904 in this State, 12,728,835 long tons, was of the red hematite variety, although some hydrated ores are known locally as "brown hematites." This output shows a decline of 2,642,561 tons, or 17 per cent, from the 1903 figures of 15,371,396 long tons. The shipments reported in 1904 are, however, greater than the production above named, due to the stocks of ore at the mines being reduced. This is the first year in which there has been a decline in the quantity of ore mined in Minnesota since the initial shipment in the year 1884.

Much has been said in regard to the early exhaustion of the iron-ore supply of the Lake Superior district, but in Minnesota alone on the Mesabi Range there are reported to be known and explored reserves approximating 500,000,000 tons, practically twice the combined shipments from all the ranges of the Lake Superior region since 1854. There are also other hematite deposits, not so rich in iron, which may in time be utilized, and in some sections important deposits of magnetites are reported, but the commercial value of these is unknown. Until late years much of Minnesota has not been thoroughly explored, and other deposits may be found which may add to the mineral wealth of the State.

Michigan.—In 1904 Michigan ranked second as a producer of iron ore, with a total of 7,089,887 long tons, a decrease from the 1903 product (10,600,330 long tons) of 3,510,443 tons, or 33 per cent. All of the ore was of the red-hematite class (in which the State occupied second place), and is obtained from the Marquette, Menominee, and Gogebic ranges.

Notwithstanding the fact that for forty years iron-ore exploitation has been actively followed in the upper Michigan peninsula, new "finds" are reported, and developments made of mining properties which had been considered exhausted indicate additional ore reserves.

Alabama.—In 1904 this State contributed three varieties of ore, 2,894,423 tons being red hematite, 787,514 tons brown hematite, and 17,944 tons magnetite. The State occupies third, first, and sixth places, respectively, in these classes. The total production of all classes, 3,699,881 tons, is an increase of 14,921 tons over the 1903 output of 3,684,960 long tons, and maintains Alabama as third in rank.

New York.—Activity in the Port Henry, Lake Champlain, district, in 1904, is chiefly responsible for advancing the State to fourth position, with a production of 842,303 tons of iron ore, of which 788,974 tons were magnetite and 53,329 tons red hematite. The rank in these classes was, respectively, first and eighth. The increase over the 1903 total of 540,460 tons was 301,843 tons, or 56 per cent.

Cargoes of rich ore, which owing to the phosphorus and silica contents were particularly desirable for the manufacture of basic pig, were exported to Germany.

Additional exploitations and the known reserves of ore suggest that the State of New York may regain and maintain her former position of prominence as a producer of iron ores.

Virginia and West Virginia.—In 1904 these two States, considered jointly in order to preserve the confidential character of reports, mined 550,253 long tons of iron ore, a falling off of 250,908 tons, or 31 per cent, from the 1903 record of 801,161 tons. The greater part of the 550,253 tons was brown hematite, in which class these States ranked second. Small quantities of red hematite and magnetite were also obtained.

Tennessee.—The quantity of iron ore mined in the year 1904 was 500,982 long tons, of which 309,419 tons were red hematite and 191,563 tons brown hematite, giving the State fifth and fourth positions, respectively, in these classes. The total for the State showed a decline of 351,722 tons, or 41 per cent, from the 1903 production of 852,704 tons.

New Jersey.—The 499,949 tons of iron ore mined in New Jersey in 1904 was all of the magnetite variety, in which class the State occupied second place. This is an increase of 15,153 long tons, or 3 per cent, over the 1903 total of 484,796 tons.

Some of the older mines where operations had been suspended for several years are now wrought to supply the demand caused by the erection of modern blast furnaces, and at some of the mines magnetic cobbing and concentration is being followed. These aided in increasing the output of the New Jersey mines in a year when most of the States showed a falling off.

Wisconsin.—The production of iron ore in Wisconsin in the year 1904 was 483,475 long tons, of which 467,475 tons were red hematite and 16,000 tons brown hematite, giving the State fourth and tenth places, respectively, in these classes of ore. This was a decline of 191,578 tons, or 28 per cent, from the 1903 total of 675,053 tons. It is probable that the year 1905 will show an advance over 1904, as the Baraboo Range in southern Wisconsin, described in the report of 1903, will be more thoroughly exploited and the mines of the Gogebic and Menominee ranges, which extend into this State, show increased activity.

Pennsylvania.—In late years this State has shown a constant decrease in iron-ore mining activity, due principally to moderate outputs from the Cornwall ore hills, and in 1904 the quantity supplied was but 397,107 long tons as compared with 644,599 tons in 1903, a difference of 247,492 tons, or 38 per cent. Of the 1904 total, 227,615 tons were magnetite, 164,206 tons brown hematite, and 5,286 tons red hematite, giving the State third, fifth, and twelfth positions in these classes, respectively.

Georgia.—This State produced 293,802 long tons of iron ore in the year 1904, a decline of 149,650 long tons, or 34 per cent, from the 1903 total of 443,452 long tons. Two classes of ore were mined; 238,596 tons were brown hematite and 55,206 tons red hematite, giving the State third and seventh places, respectively, in these classes of ore.

Montana, Nevada, New Mexico, Texas, Utah, and Wyoming.—These States combined mined 210,945 long tons of iron ore, a decrease of

181,297 long tons, or 46 per cent, from the 1903 total of 392,242[a] tons. Of this quantity 154,828 tons were red hematite, 38,919 tons magnetite, and 17,198 tons brown hematite.

Colorado.—In the year 1904 Colorado produced 150,972 long tons of iron ore, a decline of 101,937 long tons, or 40 per cent, from the 1903 total of 252,909 long tons. Of this quantity 149,526 tons were brown hematite and 1,446 tons red hematite. There were 44,694 tons smelted to produce pig iron and spiegeleisen, the remainder being utilized as flux in smelting other ores.

The decline in production of a large brown hematite ore mine is responsible for much of the decreased output of this State.

Other States.—Of the remaining States, none of which contributed 100,000 tons of iron ore in 1904, Connecticut and Massachusetts supplied brown hematite ore, Missouri red and brown hematite, Maryland brown hematite and carbonate, North Carolina brown hematite and magnetite, and Ohio carbonate ores.

PROMINENT IRON-ORE MINES.

In the year ending December 31, 1904, there were 117 iron-ore operations which produced over 50,000 long tons each, the total being 24,993,414 long tons, or 90 per cent of the United States output. In 1903 the number of larger mining operations was 141, producing 31,301,938 long tons, or 89 per cent of the total.

In 1904 of these larger mining operations 100 contributed 22,609,293 tons of red hematite, 7 supplied 954,692 tons of brown hematite, 9 reported 1,326,352 tons of magnetite, and 1 reported 103,077 tons mixed red and brown hematite. Of these operations 1 reported over 1,500,000 tons, 2 over 1,100,000 tons, 1 over 1,000,000 tons, 1 over 900,000 tons, 1 over 800,000 tons, 1 over 700,000 tons, 2 over 600,000 tons, 1 over 500,000 tons, 5 over 400,000 tons, 3 over 300,000 tons, 6 over 250,000 tons, 11 over 200,000 tons, 9 over 150,000 tons, 27 over 100,000 tons, and 46 over 50,000 tons.

Of these large mining operations 41 were in Minnesota, 36 in Michigan, 20 in Alabama, 4 in New York, 3 each in New Jersey, Wisconsin, and Tennessee, 2 in Virginia, and 1 each in Colorado, Georgia, North Carolina, Pennsylvania, and Wyoming.

The following table gives a list of the mining operations in the United States which in the year 1904 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 16 mines, the managers of which objected to such publication, these being grouped at the end of the table.

[a] In 1903 Texas supplied 34,050 tons of iron ore, and was not included in this total.

Prominent iron-ore mines of the United States, with their production in 1904.

	Long tons.
Stevenson, Minnesota	1,652,021
Mountain Iron, Minnesota	1,168,855
Burt, Minnesota	1,155,760
Red Mountain Group, Alabama	1,028,263
Fayal, Minnesota	908,824
Adams, Minnesota	823,986
Mahoning No. 3, Minnesota	706,325
Biwabik, Minnesota	647,613
Norrie Group, Michigan	639,700
Chapin, Michigan	539,009
Spruce Mining Company, Minnesota	498,450
Lake Superior, Michigan	466,762
Old Bed, New York	419,246
Pioneer, Minnesota	408,015
Pewabic, Michigan	396,359
Aragon, Michigan	376,531
Chandler, Minnesota	365,978
Cleveland Lake, Michigan	298,914
Glen, Minnesota	280,358
Aurora and Vaughn, Michigan	271,350
Ashland, Michigan	268,354
Penn Iron Mining Company, Michigan	263,490
Tilden, Michigan	248,427
Genoa, Minnesota	245,122
Cyprus, Minnesota	244,415
Leetonia, Minnesota	228,536
Tobin and Gennesee, Michigan	227,235
Sellers, Minnesota	223,836
Queen, Buffalo, S. Buffalo, and Prince of Wales, Michigan	218,935
Clark, Minnesota	216,952
Cornwall, Pennsylvania	215,015
Lake Angeline, Michigan	211,100
Savoy-Sibley, Minnesota	196,082
Hartford, Michigan	170,988
Cliff's Shaft, Michigan	170,311
Brown Mining Company, Tennessee	162,473
Crystal Falls, Michigan	158,641
Albany, Minnesota	153,339
Leonard, Minnesota	151,953
Negaunee, Michigan	150,726
Salisbury, Michigan	150,039
Duluth, Minnesota	149,829
Lincoln, Minnesota	144,735
Minorca, Minnesota	137,613
Sunrise, Wyoming	137,167
Harmony, New York	135,802
Ironaton, Alabama	133,801
Baltic, Michigan	133,306
Florence, Wisconsin	128,879
Bristol (Claire), Michigan	123,700
Republic and West Republic, Michigan	123,538

	Long tons.
Elba, Minnesota	121,600
Utica, Minnesota	121,394
Newport and Bonnie, Michigan	113,017
Atlantic, Wisconsin	112,354
La Follette Coal and Iron Company, Tennessee	112,224
Hammond Bros. Co., Alabama	112,203
Oriskany, Virginia	110,257
Montreal and Ottawa, Wisconsin	109,731
Rust, Minnesota	107,167
Chateaugay, New York	106,566
La Rue Mining Company, Minnesota	105,830
Bartow, Georgia	103,077
Wharton-Hibernia, New Jersey	102,990
Wood and De Camp, New Jersey	100,098
Hawkins, Minnesota	99,317
Jordan, Minnesota	97,473
Agnew, Minnesota	96,291
Port Henry No. 21, New York	96,240
Loretto, Michigan	95,812
Colby, Michigan	93,167
Chisholm, Minnesota	91,645
Forest, Minnesota	91,440
Malta, Minnesota	89,966
Pettit, Minnesota	88,503
Richards, New Jersey	88,398
Brotherton, Michigan	86,425
Hemlock River, Michigan	83,930
La Belle, Minnesota	81,814
Winifred, Minnesota	81,687
Zenith, Minnesota	81,643
Clifford, Michigan	81,164
Hillman, Alabama	80,167
Vivian, Michigan	77,217
Princeton, Michigan	75,486
Mannie, Tennessee	74,611
Frantz, Minnesota	74,352
Day, Minnesota	72,330
Greeley Group, Alabama	69,541
Helen-Bess, Alabama	68,487
Richmond (Gribben), Michigan	68,134
Potter, Alabama	67,170
Giles, Alabama	62,642
Valley View, Alabama	58,384
Hiawatha, Michigan	58,000
Midas, Colorado	57,370
Barbours Creek, Virginia	55,973
Beaufort, Michigan	54,300
Sunday Lake, Michigan	53,023
Attalla, Alabama	50,690
Iroquois, Minnesota	50,221
	22,968,179
16 mines not reported by name	2,025,235
Total	24,993,414

SHIPMENTS OF IRON ORE FROM THE LAKE SUPERIOR REGION.

Of the 27,644,330 tons of iron ore mined in the United States in the year 1904, 20,198,311 tons, or about three-fourths, came from the Lake Superior region, the greater portion being forwarded to shipping ports on Lake Superior and Lake Michigan, whence it was sent by vessel to Chicago and other ports, and to receiving docks on Lake Erie, and from these was transported by rail to blast furnaces in Pennsylvania, Ohio, New York, West Virginia, Virginia, etc.

There are seven shipping ports, five of which—Two Harbors, Duluth, Superior, Ashland, and Marquette—are situated on Lake Superior, and two—Escanaba and Gladstone—on Lake Michigan. The two first-mentioned ports are in Minnesota, Ashland and Superior are in Wisconsin, and the others in Michigan.

The total quantity of iron ore forwarded by vessel from the Lake Superior region in the season of 1904 was 21,226,664 long tons, and in addition 548,253 tons were sent to consuming centers by rail, a total of 21,774,917 tons.

Duluth, Minn., takes first place as a shipping port, with a total of 4,649,611 long tons, Two Harbors, Minn., being a close second with 4,566,542 tons, followed by Superior, Wis., with 4,169,990 tons; Escanaba, Mich., 3,644,267 tons; Ashland, Wis., 2,288,400 tons; Marquette, Mich., 1,907,301 tons, and Gladstone, Mich., 553 tons. The ore won from the Mesabi and Vermilion ranges in Minnesota is shipped from the ports of Duluth, Two Harbors, and Superior. That won from the Gogebic Range in Michigan and Wisconsin finds an outlet at Ashland. The mineral from the Marquette Range, Michigan, is shipped from Marquette and Escanaba; and the product of the mines of the Menominee Range in Michigan and Wisconsin is distributed from Escanaba and Gladstone. Some of the ore from the Gogebic Range also reaches the latter ports.

The shipments by ports from 1895 to 1904, inclusive, as copied from the Iron Trade Review, are as follows:

Lake shipments of iron ore, 1895–1904, 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	2,321,931	2,302,121	2,803,513	3,720,218
Duluth	1,598,783	1,988,932	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.	1904.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Two Harbors	4,007,294	5,018,197	5,605,185	5,120,656	4,566,542
Escanaba	3,436,734	4,022,668	5,413,704	4,277,561	3,644,267
Duluth	3,888,986	3,437,955	5,598,408	5,356,473	4,649,611
Ashland	2,633,687	2,886,252	3,553,919	2,823,119	2,288,400
Marquette	2,661,861	2,354,284	2,595,010	2,007,346	1,907,301
Superior	1,522,899	2,321,077	4,180,568	3,978,579	4,169,990
Gladstone	418,854	117,089	92,375	85,816	553
Total	18,570,315	20,157,522	27,039,169	23,649,550	21,226,664
All-rail shipments	489,078	431,715	531,952	632,045	548,253
Grand total	19,059,393	20,589,237	27,571,121	24,281,595	21,774,917

The different railroads connecting with the shipping ports of the Lake Superior region have erected numerous ore docks at great expense. Many of these are of large size, the maximum capacity being 87,500 tons. Through the courtesy of Mr. R. Angst, chief engineer of the Duluth and Iron Range Railroad, a list of these docks, revised to May 1, 1905, is presented, which gives the number of pockets, the height, width, and length of dock, etc.

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

Railway.	Location.	Dock No.	Number of pockets.	Total storage capacity.	Height water to deck of dock.	Width of dock outside to outside of partition posts.	Length of dock.
				Tons.	*Ft. In.*	*Ft. In.*	*Feet.*
Chicago and Northwestern Railway.	Escanaba, Mich	1	184	24,104	48 6	37 0	1,104
Do	do	3	226	30,284	52 8	37 0	1,356
Do	do	4	250	32,750	59 2	37 0	1,500
Do	do	5	232	43,152	53 3	37 0	1,392
Do	do	6	320	58,000	70 0	50 2	1,920
Do	Ashland, Wis	1	234	42,120	70 0	48 0	1,404
Do	do	2	234	25,740	57 8	46 0	1,404
Duluth and Iron Range Railroad.	Two Harbors, Minn	1	202	40,400	59 6	49 0	1,388
Do	do	2	208	41,600	57 6	49 0	1,280
Do	do	3	170	34,000	66 0	49 0	1,054
Do	do	4	168	36,960	62 0	49 0	1,042
Do	do	5	168	33,600	54 6	49 0	1,042
Duluth, Missabe and Northern Railway.	Duluth, Minn	1	384	57,600	53 0	49 0	2,336
Do	do	2	384	69,120	57 6	49 0	2,336
Do	do	3	384	80,640	67 ½	59 0	2,304
Great Northern Railway	Superior, Wis	1	250	40,500	57 0	49 0	1,525
Do	do	2	350	87,500	72 8	62 8	2,100
Do	do	3	160	40,000	72 8	62 8	960
Duluth, South Shore and Atlantic Railway.	Marquette, Mich	1	270	27,000	45 0	40 0	1,700
Do	do	4	200	28,000	47 3	36 8	1,200
Lake Superior and Ishpeming Railway.	do	1	200	36,000	54 0	50 0	1,232
Wisconsin Central Railway.	Ashland, Wis	1	314	48,356	66 2	36 0	1,908
Chicago, Milwaukee and St. Paul Railway.	Escanaba, Mich	1	240	50,400	66 6	52 0	1,500
Algoma Central and Hudson Bay Railway.	Michipicoten, Ontario	1	12	....	43 4	25 0	(b)

[a] Revised to May 1, 1905. [b] 311 feet 9 inches.

The total iron-ore traffic of the Great Lakes in 1904 was 21,343,627 long tons, of which 21,226,664 tons were shipped from American ports, and 116,963 tons from the Michipicoten Range of Ontario, Canada. Of these last, 40,547 tons were sent to Canadian ports, leaving the total shipped to American ports 21,303,080 tons. By far the greater part of this was sent to Lake Erie ports, the quantity forwarded in the year 1904 being 17,932,814 tons. The difference between this quantity and the 21,303,080 tons noted above represents the tonnage sent to furnaces located at or near Lake Michigan, at Detroit, etc., this quantity being for the year 1904 3,370,266 long tons.

In 1904 Conneaut, Ohio, received 4,083,655 long tons, and occupied first place, followed by Ashtabula, Ohio, with 3,639,250 tons, Cleveland, Ohio, with 3,572,228 tons, Buffalo and Tonawanda, N. Y., with

2,433,601 tons, Erie, Pa., with 1,284,778 tons, and Fairport, Ohio, with 1,157,858 tons. None of the other lake ports received 1,000,000 tons; they ranked in the following order: Lorain, Ohio; Toledo, Ohio; Huron, Ohio, and Sandusky, Ohio.

The table below shows the receipts of iron ore at lower lake ports from 1895 to 1904, inclusive:

Iron-ore receipts at Lake Erie ports, 1895–1904.

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	241,967	327,623	495,327	1,401,169	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.	1904.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Ashtabula, Ohio	3,709,486	3,981,170	4,796,805	4,242,160	3,639,250
Cleveland, Ohio	3,376,644	3,831,060	4,873,318	4,434,160	3,572,228
Conneaut, Ohio	2,556,631	3,181,019	4,300,301	3,903,937	4,083,655
Buffalo and Tonawanda, N. Y	1,616,919	1,475,386	2,256,798	2,149,901	2,433,601
Erie, Pa	1,240,715	1,379,377	1,717,268	1,257,798	1,284,778
Fairport, Ohio	1,085,554	1,181,776	1,538,744	1,434,342	1,157,858
Toledo, Ohio	645,147	798,298	1,037,571	652,305	508,793
Lorain, Ohio	1,090,235	721,662	1,442,417	990,490	972,931
Huron, Ohio	321,914	431,311	520,646	486,106	231,364
Sandusky, Ohio	154,542	33,017	165,556	130,532	48,356
Total	15,797,787	17,014,076	22,649,424	19,681,731	17,932,814

When the iron ore is received at lower lake ports it is either loaded directly on railroad cars for conveyance to blast furnaces or else stocked at the docks. These stock piles are then drawn upon when needed. The quantity of this ore on hand at the docks on December 1, 1904, was 5,763,399 long tons, a decrease from December 1, 1903, of 607,686 long tons or about 10 per cent, this reserve being the smallest quantity of ore on hand at lower lake ports since the year 1899.

The following table gives the stock of ore on hand at the different lower lake ports on December 1 for the years 1895 to 1904, inclusive:

Stocks of iron ore at lower lake ports, December 1, 1895–1904.

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	605,470	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	139,982	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.	1904.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Ashtabula, Ohio	1,811,459	1,769,145	1,967,136	1,911,911	1,403,575
Cleveland, Ohio	1,337,445	1,378,060	1,500,604	1,337,750	1,237,033
Fairport, Ohio	611,717	710,590	924,236	845,946	660,420
Erie, Pa	480,734	470,718	722,966	657,409	583,439
Lorain, Ohio	251,838	195,863	328,304	288,581	299,504
Conneaut, Ohio	630,514	604,106	673,679	591,364	684,487
Toledo, Ohio	242,375	254,196	310,023	106,710	318,573
Huron, Ohio	211,377	231,501	232,764	253,249	182,495
Buffalo, N. Y	232,100	198,100	319,367	282,890	318,739
Sandusky, Ohio	95,111	47,384	95,175	95,275	75,134
Total	5,904,670	5,859,663	7,074,254	6,371,085	5,763,399

The stocks of ore on hand at the lower lake ports are drawn upon during the season when lake navigation is suspended, but usually they are not entirely exhausted, the quantity on hand May 1, 1905, being 2,271,631 long tons, the lowest since the year 1900.

These docks are mostly owned by railroad companies, who, to discourage accumulation, grant rebates on ore which is transferred directly to the cars.

The stocks of ore on hand at lower lake ports on May 1 for the years 1896 to 1905, inclusive, as copied from the Iron Trade Review, are as follows:

Stocks of iron ore at lower lake ports, May 1, 1896–1905.

Port.	At opening of navigation, May 1—				
	1896.	1897.	1898.	1899.	1900.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Ashtabula, Ohio	636,251	926,865	1,031,411	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	16,641	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.	1905.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Ashtabula, Ohio	1,046,974	924,742	1,073,967	1,559,028	623,451
Cleveland, Ohio	806,119	624,865	829,347	968,508	513,559
Fairport, Ohio	306,706	472,325	555,709	579,677	390,869
Erie, Pa	225,412	223,972	426,744	474,275	236,414
Lorain, Ohio	140,562	96,992	190,311	237,404	165,586
Conneaut, Ohio	69,755	152,891	125,400	128,018	96,295
Toledo, Ohio	138,457	111,511	126,331	160,216	71,642
Huron, Ohio	135,043	129,635	147,817	208,008	68,100
Buffalo, N. Y	118,007	73,861	60,241	150,106	61,271
Sandusky, Ohio	63,148	37,400	56,500	68,863	44,444
Total	3,050,183	2,848,194	3,592,367	4,534,103	2,271,631

VALUE OF IRON ORES.

The total value at the mines of the 27,644,330 tons of iron ore produced in the United States in the year 1904 was $43,186,741, or $1.56 per ton, a decrease of 33 cents, or 17 per cent, from the 1903 average figures of $1.89 per ton.

The Lake Superior Ore Association, which for a number of years has fixed the price of Lake Superior iron ores, was practically dissolved in 1904, except for statistical purposes, and no fixed basis price was agreed upon at lower lake ports. The average, however, was about $3.25 for Bessemer Old Range ore; $2.85 for non-Bessemer Old Range ore; $3 for Mesabi Bessemer ore, and $2.75 for Mesabi non-Bessemer ore.

The data collected show that the highest value placed on ore at the mine was $3.04 in Connecticut and Massachusetts, where brown hematites are exploited on a moderate scale, and the lowest, $1 per ton, in Kentucky. Of the States comprising the Lake Superior region the average price per ton at the mines was, in Michigan, $1.97; in

Wisconsin, $1.77; and in Minnesota, $1.43; these were differences of 43 cents, 52 cents, and 32 cents less per ton from the average 1903 figures of $2.40, $2.29, and $1.75 per ton.

The following table gives, by States, the total production and value of the iron ore mined in the year 1904, together with the average value per ton at the mines.

Quantity and value of iron ore produced in 1904, by States.

State.	Production.	Total value at mines.	Average value per ton.
Minnesota	12,728,835	$18,141,902	$1.43
Michigan	7,089,887	13,936,261	1.97
Alabama	3,699,881	3,744,350	1.01
New York	842,303	1,885,291	2.24
Virginia and West Virginia	550,253	951,478	1.73
Tennessee	500,982	566,813	1.13
New Jersey	499,949	1,126,687	2.25
Wisconsin	483,475	856,710	1.77
Pennsylvania	397,107	611,211	1.54
Georgia	293,802	356,950	1.22
Montana, Nevada, Texas, New Mexico, Utah, and Wyoming	210,945	264,297	1.25
Colorado	150,972	429,856	2.85
North Carolina	64,347	80,440	1.25
Missouri	49,285	92,820	1.88
Kentucky	35,000	35,000	1.00
Connecticut and Massachusetts	21,990	66,839	3.04
Ohio	15,672	21,829	1.39
Maryland	9,645	18,007	1.87
Total	27,644,330	43,186,741	1.56

STOCKS OF IRON ORES.

At the close of the year 1904 the total stock of ore on hand at the mines was 4,666,931 long tons, a decrease of 1,630,957 long tons, or 26 per cent, from the 6,297,888 tons reported on December 31, 1903.

Of this stock on hand December 31, 1904, 4,284,574 long tons, or 92 per cent, was in the States of Michigan, Minnesota, and Wisconsin, forming the Lake Superior region, whence the bulk of the ore is transported by water to receiving ports on Lake Erie, and during the time of the suspension of navigation by cold weather the ore accumulates at the mines. Over one-half of the total ore on hand was at the Michigan mines.

The following table shows the quantity of ore on hand at the mines on December 31, 1904:

Stocks of iron ore on hand at the mines December 31, 1904, by States.

State.	Quantity.	State.	Quantity.
	Long tons.		*Long tons.*
Michigan	2,955,586	Ohio	10,600
Minnesota	1,221,082	Georgia	4,265
Alabama	171,769	Missouri	4,260
Wisconsin	107,906	Iowa	3,000
New York	66,581	Virginia and West Virginia	2,420
New Jersey	45,870	Connecticut and Massachusetts	1,639
Tennessee	32,626	Maryland	50
Montana, Nevada, New Mexico, Texas, Utah, and Wyoming	21,627	Total	4,666,931
Pennsylvania	17,650		

The total available supply of iron ore is approximately indicated by adding to the stocks in reserve at the mines, the accumulation at the receiving ports, and estimates as to the quantities held in the stock yards of blast-furnace plants. A considerable quantity of the ore held at receiving ports may have been sold to blast-furnace companies, but not delivered.

IMPORTS OF IRON ORE.

The Bureau of Statistics of the Department of Commerce and Labor has supplied data in regard to the imports and exports of iron ore in the year 1904, which are given below, other years being included in the table, for the purpose of comparison.

Owing to the decline in the demand for and manufacture of pig iron, the quantity of iron ore imported decreased from 980,440 long tons, valued at $2,261,008 in 1903, to 487,613 long tons, valued at $1,101,384 in 1904. Of this total 364,630 tons came from mines operated by American capital in the island of Cuba, 77,887 tons from Quebec and Ontario (almost all of which was from the Michipicoten Range), 36,810 tons from Spain, the remainder being from various other countries, Newfoundland and Greece contributing the larger part. The average value of the iron ore imported in 1904 was $2.26 per ton, a decline of 5 cents per ton from the 1903 average of $2.31 per ton.

The table given below shows the quantities and values of iron ore imported by countries in the years 1897 to 1904, inclusive:

Quantity and value of iron ores imported into the United States, 1897–1904, by countries.

Imported from—	1897. Quantity.	1897. Value.	1898. Quantity.	1898. Value.	1899. Quantity.	1899. Value.	1900. Quantity.	1900. Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
Cuba	383,820	$454,709	165,623	$187,721	360,813	$449,616	431,265	$537,496
Spain	66,193	167,878	13,335	34,932	145,206	339,058	253,694	494,668
French Africa	3,504	7,785			22,233	51,746	20,000	23,536
Italy					43,363	122,786	18,951	50,945
Greece			7,200	26,581	16,765	27,556	23,350	31,685
Newfoundland and Labrador	29,250	29,431			77,970	77,970	140,535	142,685
United Kingdom	358	4,091	683	5,385	172	994	397	3,274
Colombia							3,000	4,854
Germany							145	1,339
Netherlands							181	854
Quebec, Ontario, etc							5,588	10,139
Venezuela							700	1,621
Sweden and Norway							25	100
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	897,831	1,303,196

Imported from—	1901. Quantity.	1901. Value.	1902. Quantity.	1902. Value.	1903. Quantity.	1903. Value.	1904. Quantity.	1904. Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
Cuba	526,583	$705,086	696,375	$1,576,619	613,585	$1,501,480	364,630	$822,413
Spain	180,810	399,364	153,527	338,259	94,720	196,139	36,810	89,218
French Africa			19,167	35,707	7,830	14,586		
Greece	12,950	42,896					2,500	2,535
Newfoundland and Labrador	a 79,360	79,360	81,920	81,918	a 86,730	86,680	5,400	5,400
United Kingdom	490	15,939	1,269	17,882	6,843	31,868	173	2,093
British Columbia	2,875	4,313	5,661	9,312	525	789		
Germany	400	3,415	361	3,478	207	1,820	2	70
Netherlands							1	10
Quebec, Ontario, etc	163,383	408,431	203,824	509,711	169,681	424,440	77,887	177,966
Belgium			500	4,850	300	2,964	210	1,671
France			2,866	5,341				8
Other countries	b 99	469			19	242		
Total	966,950	1,659,273	1,165,470	2,583,077	980,440	2,261,008	487,613	1,101,384

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.

Of the iron ore imported in the year 1904, 409,521 long tons were received at the Atlantic Ocean ports, 321,920 tons being entered at Baltimore, 72,186 tons at Philadelphia, the remainder at New York, Boston, and Richmond. At the lake ports 77,882 tons were reported as received, and 210 tons at San Francisco, Cal.

The following table shows the imports by customs districts from 1898 to 1904, inclusive.

The values given in this and the preceding table are the prices at ports of shipment, and do not include freight rates or the duty of 40 cents per ton. The high valuation on some of the small shipments is due to constituents other than iron, or to special adaptability for specific purposes.

Imports of iron ore into the United States, 1898–1904, 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						
Richmond, 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	236	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						
Columbus, Ohio						
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, 1898–1904, by customs districts—Continued.

Port.	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
Baltimore, Md	484,035	$733,071	600,711	$1,401,326	490,920	$1,232,546	321,920	$738,010
Delaware								
Philadelphia, Pa	298,255	459,698	338,848	597,895	303,722	560,880	72,186	143,892
New York, N. Y	15,865	45,863	14,546	39,800	6,940	19,759	15,263	38,765
Boston, Mass			50	142	650	2,435	132	904
Newport News, Va			197	8,130	3,397	8,825		
Norfolk and Portsmouth, Va	1,850	1,850						
Richmond, Va							20	168
Total Atlantic ports	800,005	1,240,482	954,352	2,047,293	805,629	1,824,445	409,521	921,739
Cape Vincent, N. Y								
Buffalo Creek, N. Y	53,327	146,596	53,286	133,377	23,167	57,798	56	85
Cuyahoga, Ohio	107,810	256,936	123,476	308,951	122,021	305,804	48,945	111.974
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	37	56
Vermont	48	186	18	72	760	1,190	1,183	2,457
Erie			22,821	57,024	23,325	58,314	27,661	63,394
Miami			3,962	9,905				
Total lake ports	163,363	408,401	203,809	509,688	169,681	424,440	77,882	177,966
Saluria, Tex. (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	210	1,671
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	210	1,671
Pittsburg, Pa	50	730	50	742				
Evansville, Ind	20	30						
Columbus, Ohio								8
Total interior ports	70	760	50	742				8
Total imports	966,950	1,659,273	1,165,470	2,583,077	980,440	2,261,008	487,613	1,101,384

EXPORTS OF IRON ORES.

Until the year 1899 the exports of iron ore from the United States were comparatively small, but in that year iron ore was sent to blast furnaces located in the Province of Ontario, Canada, and this has shown an almost uninterrupted increase from 40,665 tons in 1889 to 213,865 tons in 1904. In late years, however, there has been a demand for ores rich in iron and high in phosphorus for use in the manufacture of basic metal in Germany, which has encouraged the export of ore from the Port Henry district in New York. The 213,865 tons of ore exported in 1904, valued at $458,823, or $2.15 per ton, was an increase of 133,254 tons, or one and two-thirds times the 1903 exports of 80,611 tons, valued at $255,728 ($3.17 per ton).

The annexed table gives the exports of iron ore from the United States by customs districts from 1899 to 1904, inclusive:

Exports of iron ore from the United States, 1899–1904, 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.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
New York	204	$2,227	331	$2,000	25,779	$51,718
Niagara	802	1,708				
Superior	19,157	63,772	70,870	223,432	138,946	270,309
Duluth	49,233	152,454	5,006	13,463	38,582	113,664
Paso del Norte						
Saluria						
Detroit	115	408				
Huron					18	171
Champlain	18,876	73,348	4,314	16,548	10,284	22,009
Newport News						
Buffalo Creek	58	251	90	285	176	502
Memphremagog						
Vermont						
Puget Sound					80	450
Total	88,445	294,168	80,611	255,728	213,865	458,823

CUBA.

The greater portion of the iron ore imported into the United States comes from the province of Santiago de Cuba, in the southeastern portion of the island of Cuba, the mines being owned and operated by American companies.

Only two companies, the Juragua Iron Company (Limited) and the Spanish-American Iron Company, are now active, the Sigua Iron Company, which in 1892 and 1893 produced 20,438 long tons, and the Cuban Steel Ore Company, which in 1901 and 1902 contributed 41,241 tons, having ceased operations. The Juragua Iron Company (Limited) since its initial shipment in 1884 has forwarded a total of 4,098,855, long tons, of which 31,162 tons were shipped in 1904. The Spanish-American Iron Company, which was first exploited in 1895, has contributed a total of 2,600,952 long tons, of which 356,111 long tons were shipped in 1904.

The total quantity of iron ore obtained from Cuba from 1884 to 1904, inclusive, was 6,761,486 long tons, all of which was forwarded to the United States except 86,597 tons sent to foreign ports.

The table below shows the shipments of iron ore from mines in the province of Santiago de Cuba from 1884 to 1904, inclusive, the data for the latter year having been supplied by the Juragua Iron Company (Limited) and the Spanish-American Iron Company.

Shipments of iron ore from mines in the province of Santiago de Cuba, 1884–1904.

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
1904	31,162		[e] 356,111		387,273
Total	4,098,855	20,438	2,600,952	41,241	6,761,486

[a] Of this quantity, 5,932 tons were sent to Pictou, Nova Scotia.
[b] Of this quantity, 51,537 tons were sent to foreign ports.
[c] Of this quantity, 12,691 tons were sent to foreign ports.
[d] Of this quantity, 10,900 tons were sent to foreign ports.
[e] Of this quantity, 5,537 tons were sent to foreign ports.

Total...... 86,597 tons sent to foreign ports.

STATISTICS OF THE AMERICAN IRON TRADE FOR 1904.

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

BRIEF REVIEW OF THE AMERICAN IRON TRADE IN 1904.

The reaction in general business conditions in this country which began in the first half of 1903 continued until August and September of 1904, when unmistakable signs of the end of the reaction were visible on every hand. In October business confidence was entirely reestablished. Before the close of this month railroad and industrial stocks had greatly advanced in price and the manufacturing industries of the country were again as active as if nothing had happened to interrupt their prosperity. The railroads were busy moving the good crops of the year and the products of our mines, forests, and manufacturing establishments. This favorable condition of business continued all through the winter, notwithstanding its exceptional severity, and has been continued without abatement through the spring months of the present year. In April railroad and other stocks reached still higher figures than during the preceding fall and winter. Prices of farm products have continued in the main to be satisfactory to the farmers.

The improvement in general trade conditions noted above has particularly affected the iron trade, so much so that for several months the demand for iron and steel products in this country has never been equaled. It has taxed and is still taxing our manufacturing plants to their utmost available capacity. This extraordinary activity is probably of more general application to all branches of the iron trade than any similar demand in other years. Certainly American manufacturers of pig iron, steel rails, structural steel, plates and sheets, cars and locomotives (including railroad shops), and general machinery and foundry products were never more actively employed than they are to-day. The whole country urgently wants iron and steel for a thousand uses. The export trade in some iron and steel branches is also contributing to the general activity. But the greatest demand for iron and steel comes from the railroads. The fact is now generally recognized that railroad managers have not kept abreast of the country's marvelous industrial development in the last few years. More tracks, more cars, and more locomotives have been needed than had been built, and also more bridges and better terminal facilities. Some of these managers awakened to the necessity of meeting these deficiencies before the general revival of prosperous conditions last year, but others did not awaken to the needs of their roads until the present year, and it is to the suddenness of this awakening that much of the existing unprecedented demand for iron and steel is due.

The decline in the production of iron and steel, which began in the second half of 1903, was not generally arrested in the first half of 1904 and was particularly noticeable in June and July, but it was entirely checked in August and September. The production during the year was less in many lines than in 1903, the increased activity in the last few months of the year falling very far short of equaling the losses in production during the remainder of the year. The production in all lines in 1905 promises to be much the largest in the history of the country. The production of pig iron in the first half of 1905 was 11,163,175 long tons, against 8,323,595 tons in the last half of 1904 and 8,173,438 tons in the first half of 1904. The increase in production in the first half of 1905 as compared with the second half of 1904 amounted to 2,839,580 tons, and as compared with the first half to 2,989,737 tons.

Naturally and properly prices of iron and steel have advanced since the improvement in demand began in August and September of last year, but this advance has wisely been kept within reasonable bounds. Steel rails have not been advanced at all. Such advances as have taken place have been justified in large part by advances in the prices of raw materials. Prices in 1904 were at their lowest ebb in the third quarter; some prices were the lowest that had been reached since the reaction in 1903 began. The average monthly price of Bessemer pig iron at Pittsburg fell in September, 1904, to $12.69 per ton, from which there was a gradual advance to an average of $16.72 in December and January. At the end of April the price was $16.35.

The workingmen employed at iron and steel works and in auxiliary mining operations and at coke works have shared in the general revival of prosperity. They have had steady employment and their wages have been increased from 10 to 20 per cent.

GENERAL STATISTICAL SUMMARY.

The following table gives the shipments in 1903 and 1904 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 1903 and 1904.

[Long tons, except for coke and nails.]

Item.	1903.	1904.
Shipments of iron ore from Lake Superior	24,289,878	21,822,839
Total production of iron ore	35,019,308	27,644,330
Shipments of Pennsylvania anthracite coal	59,362,831	57,492,522
Total production of all kinds of coal	319,068,229	314,421,255
Total production of coke ... short tons	25,262,360	23,621,520
Shipments of Connellsville coke ... do	13,345,230	12,427,468
Shipments of Pocahontas Flat Top coke ... do	1,693,403	1,617,801
Production of pig iron, including spiegeleisen and ferromanganese	18,009,252	16,497,033
Production of spiegeleisen, ferromanganese, and ferrophosphorous	192,661	220,392
Production of Bessemer steel ingots and castings	8,592,829	7,859,140
Production of open-hearth steel ingots and castings	5,829,911	5,908,166
Production of all kinds of steel ingots and castings	14,534,978	13,859,887
Production of structural shapes, not including plates	1,095,813	949,146
Production of plates and sheets, except nail plate	2,599,665	2,421,398
Production of all rolled iron and steel, except rails	10,215,220	9,728,670
Production of Bessemer steel rails	2,946,756	2,137,957
Production of all kinds of rails	2,992,477	2,284,711
Production of iron and steel wire rods	1,503,455	1,699,028
Production of all rolled iron and steel, including rails	13,207,697	12,013,381
Production of iron and steel cut nails ... kegs of 100 pounds	1,435,893	1,283,362
Production of iron and steel wire nails ... do	9,631,661	11,926,661
Imports of iron ore	980,440	487,613
Exports of iron ore	80,611	213,865
Imports of iron and steel, foreign value	$41,255,864	$21,621,970
Exports of iron and steel, home value	$99,035,865	$128,553,613
Miles of new railroad built (estimated for 1904)	4,715	4,252
Tonnage of steel vessels built in the calendar year	295,840	160,809

An examination of the foregoing table will show how general was the reaction in the iron trade and auxiliary industries in 1904. There was a shrinkage in that year in nearly all lines of production as compared with 1903. The decrease in the production of pig iron was 1,512,219 long tons; in Bessemer steel ingots and castings, 733,689 long tons; and in all kinds of rails, 707,716 long tons. The decrease in the shipments of Pennsylvania anthracite coal was 1,870,309 long tons; in Lake Superior iron ore, 2,467,039 long tons, and in Connellsville coke, 917,762 short tons. The only noteworthy increases in production in 1904 as compared with 1903 were in open-hearth steel, 78,255 long tons; in wire rods, 195,573 long tons; and in wire nails, 2,295,000 kegs. The decline in imports of iron and steel in 1904 as compared with 1903, and the increase in exports were features of the iron trade in 1904 which helped to mitigate the severity of the reaction in that year.

EXPORTS OF IRON AND STEEL.

According to the Bureau of Statistics of the Department of Commerce and Labor the statistics of domestic exports of iron and steel in the calendar years 1903 and 1904, were as follows:

Exports of domestic iron and steel in 1903 and 1904.

Article.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Pig iron	20,379	$384,334	49,025	$764,543
Scrap and old	8,034	117,972	26,785	373,329
Bar iron	19,380	796,631	29,582	1,133,128
Steel bars or rods, other than wire rods	17,802	929,915	25,894	1,240,728
Steel wire rods	22,360	713,718	20,073	695,448
Iron rails	181	8,808	1,405	23,870
Steel rails	30,656	937,779	414,845	10,661,222
Billets, ingots, and blooms	5,445	141,924	314,324	6,150,035
Hoop, band, and scroll	2,141	101,839	3,435	162,039
Iron sheets and plates	4,782	273,618	4,728	248,120
Steel sheets and plates	13,312	657,713	50,477	2,064,241
Tin plates and terne plates	292	28,481	7,898	651,774
Structural iron and steel	30,641	1,788,556	55,514	2,777,768
Wire	108,521	5,528,726	118,581	5,935,093
Cut nails and spikes	8,890	424,985	9,274	416,455
Wire nails and spikes	31,453	1,410,105	32,788	1,599,005
All other, including tacks	2,321	288,395	3,046	350,837
Car wheels ....number	18,966	136,569	24,763	175,947
Castings, not elsewhere specified		1,765,901		1,372,314
Cutlery		389,837		435,092
Firearms		1,206,951		1,486,151
Cash registers ....number	20,260	1,825,503	20,070	1,871,100
Locks, hinges, etc		6,986,357		5,553,473
Saws		495,729		570,056
Tools, not elsewhere specified		4,658,972		5,053,084
Electrical machinery		5,104,502		6,675,766
Laundry machinery		552,291		512,542
Metal-working machinery		3,316,088		3,483,232
Printing presses, and parts of		1,143,122		1,450,993
Pumps and pumping machinery		2,729,288		2,733,625
Sewing machines		5,340,474		6,019,161
Shoemaking machinery		834,995		1,240,096
Fire engines ....number	8	16,657	3	5,062
Locomotive engines ....do	287	3,099,521	517	4,697,340
Stationary engines ....do	1,730	714,508	2,155	1,099,690
Parts of engines and boilers		2,273,834		2,003,323
Typewriting machines, and parts of		4,537,396		4,138,651
Wood-working machinery [a]		359,338		628,714
All other machinery		20,068,810		22,918,952
Pipes and fittings		5,919,340		7,303,900
Safes ....number	3,740	209,544	4,552	242,815
Scales and balances		762,305		608,513
Stoves, ranges, and parts of		981,475		810,971
All other manufactures		9,073,059		10,215,415
Total	326,590	99,035,865	1,167,674	128,553,613
Agricultural implements, additional		22,951,805		21,654,892
Iron ore	80,611	255,728	213,865	458,823

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

EXPORTS OF AGRICULTURAL IMPLEMENTS.

The exports of agricultural implements from the United States amounted in the calendar year 1904 to $21,654,892, against $22,951,805 in 1903, $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 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 imports of iron and steel and manufactures thereof in the calendar years 1903 and 1904:

Imports of iron and steel into the United States in 1903 and 1904.

Article.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Pig iron, spiegeleisen, ferromanganese, etc	599,574	$11,173,302	79,500	$1,765,107
Scrap iron and scrap steel	82,921	1,273,941	13,461	189,506
Bar iron	43,393	1,904,469	20,911	918,842
Iron and steel rails	95,555	2,159,273	37,776	808,775
Hoop, band, and scroll iron or steel	1,525	74,898	2,135	60,934
Steel ingots, billets, blooms, etc	261,570	7,331,299	10,801	1,535,943
Sheet, plate, and taggers' iron or steel	11,557	540,272	4,165	302,500
Building forms, and all other structural shapes, fitted for use	8,865	256,265	7,203	210,936
Tin plates and terne plates	47,360	2,999,252	70,652	4,354,761
Wire rods, of iron or steel	20,836	1,028,977	15,313	707,779
Wire, and articles made from	5,018	728,430	3,956	624,892
Anvils	250	35,378	167	24,192
Chains	373	62,481	358	50,583
Cutlery	....	1,903,895	....	1,811,511
Files, file blanks, rasps, and floats	....	82,939	....	80,994
Firearms	....	687,917	....	586,571
Shotgun barrels, in single tubes	....	198,126	....	186,945
Machinery	....	3,927,165	....	2,792,885
Needles	....	466,294	....	428,975
All other	....	4,421,291	....	4,179,339
Total	1,178,797	41,255,864	266,398	21,621,970

The large imports of iron and steel in 1903 were caused by the abnormally large demand in 1902 and in the early part of 1903, many orders sent abroad in 1902 not being filled until 1903; but the great decline in the imports of iron and steel in 1904 was due to the reaction in the home demand in the second half of 1903, which continued into the summer of 1904.

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. This increase was not continued in 1904, but there will again be an increase in 1905.

In February, 1905, a cargo of 4,000 tons of English pig iron was received at Philadelphia to be exported back to England, with benefit of tariff drawback, as cast-iron pipe. Other purchases of foreign pig iron have since been made to be used in the export trade in steel rails and other finished products.

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 1903 and 1904 and in the first four months of 1905. 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, 1903, to April, 1905, 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, 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, at Pittsburg.	Bar steel, at mills, at Pittsburg.
1903.										
January	$23.50	$21.00	$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
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	16.25	15.12	13.19	12.30	13.10	28.00	19.50	1.71	1.50	1.30
November	17.70	16.40	14.75	14.25	15.15	28.00	20.40	1.71	1.52	1.32
December	20.25	17.62	16.00	15.85	16.72	28.00	21.00	1.81	1.76	1.38
1905.										
January	22.00	17.75	16.06	16.11	16.72	28.00	22.50	1.91	1.80	1.45
February	23.00	17.75	15.62	15.99	16.20	28.00	23.37	1.91	1.80	1.45
March	24.20	18.00	16.00	16.00	16.35	28.00	23.70	1.91	1.90	1.50
April	24.50	18.25	16.00	15.77	16.35	28.00	23.75	1.91	1.82	1.50

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 1900 to 1904. 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, 1900–1904.

Article.	1900.	1901.	1902.	1903.	1904.
Old iron T rails, at Philadelphia	$19.51	$19.32	[illegible]	$21.17	[illegible]
No. 1 foundry pig iron, at Philadelphia	19.98	15.87	22.19	18.92	15.57
Gray forge pig iron, at Philadelphia	16.49	[illegible]	[illegible]	17.14	13.67
Gray forge pig iron, at Pittsburg	16.90	14.20	19.49	17.52	12.89
Bessemer pig iron, at Pittsburg	19.49	15.93	20.67	18.98	13.76
Steel rails, at mills, in Pennsylvania	32.29	27.33	28.00	28.00	28.00
Steel billets, at mills, at Pittsburg	25.06	24.13	30.57	27.91	22.18
Best bar iron, from store, at Philadelphia	1.96	1.84	2.13	2.00	1.72
Best bar iron, at mills, at Pittsburg	2.17	1.80	1.94	1.77	1.48
Steel bars, at mills, at Pittsburg	1.63	1.47	1.67	1.56	1.32
Cut nails, from store, at Philadelphia	2.46	2.29	2.29	2.30	2.01
Wire nails, base price, at Chicago	2.76	2.41	2.15	2.13	1.96

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 1898 to 1904:

Average monthly prices of steel bars at Pittsburg, Pa., per 100 pounds, 1898–1904.

Month.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	$1.00	$1.07	$2.25	$1.20	$1.58	$1.64	$1.30
February	1.00	1.09	2.25	1.27	1.50	1.60	1.30
March	.99	1.48	2.25	1.44	1.50	1.60	1.33
April	.95	1.75	2.12	1.50	1.67	1.60	1.35
May	.95	1.71	1.94	1.50	1.80	1.60	1.32
June	.95	2.05	1.79	1.50	1.80	1.60	1.30
July	.95	2.00	1.24	1.52	1.72	1.60	1.30
August	.96	2.21	1.05	1.50	1.75	1.60	1.31
September	.99	2.50	1.12	1.50	1.75	1.60	1.33
October	1.00	2.60	1.15	1.52	1.69	1.60	1.30
November	1.01	2.46	1.18	1.60	1.60	1.37	1.32
December	1.00	2.25	1.20	1.60	1.68	1.30	1.38
Average	.98	1.93	1.63	1.47	1.67	1.56	1.32

The lowest quoted price at which steel bars were sold at Pittsburg within the last seven years was 95 cents per 100 pounds; this price prevailed in April, May, June, and July, 1898.

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 1897, as reported by the Duncannon Iron Company:

Average monthly prices of cut nails at Philadelphia, from store, 1897–1904.

[Per keg of 100 pounds.]

Month.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	$1.60	$1.35	$1.40	$2.80	$2.25	$2.30	$2.33	$2.05
February	1.55	1.35	1.65	2.80	2.27	2.20	2.36	2.00
March	1.55	1.30	1.75	2.80	2.27	2.25	2.36	2.00
April	1.50	1.30	1.95	2.62	2.30	2.30	2.41	2.05
May	1.45	1.30	1.95	2.45	2.30	2.30	2.41	2.05
June	1.45	1.30	2.20	2.42	2.30	2.30	2.41	2.05
July	1.40	1.30	2.30	2.30	2.30	2.30	2.41	2.05
August	1.40	1.30	2.35	2.30	2.30	2.30	2.41	2.00
September	1.45	1.30	2.60	2.25	2.35	2.30	2.41	1.95
October	1.45	1.30	2.75	2.28	2.30	2.30	2.41	1.90
November	1.40	1.30	2.80	2.30	2.30	2.30	2.20	2.00
December	1.40	1.30	2.80	2.25	2.30	2.30	2.20	2.05
Average	1.47	1.31	2.21	2.46	2.29	2.29	2.36	2.01

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 1897 to 1904, inclusive:

Average monthly prices of standard sizes of wire nails at Chicago, 1897–1904.

[Per keg of 100 pounds.]

Month.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	$1.50	$1.55	$1.59	$3.53	$2.35	$2.16	$2.08	$2.04
February	1.45	1.57	1.73	3.53	2.45	2.20	2.12	2.05
March	1.50	1.55	2.09	3.53	2.45	2.20	2.20	2.09
April	1.45	1.47	2.25	3.28	2.45	2.20	2.15	2.10
May	1.42	1.45	2.35	2.53	2.45	2.20	2.15	2.10
June	1.42	1.43	2.60	2.48	2.45	2.20	2.15	2.07
July	1.35	1.36	2.70	2.43	2.45	2.20	2.15	2.05
August	1.37	1.36	2.80	2.43	2.45	2.20	2.15	1.90
September	1.50	1.45	3.10	2.35	2.45	2.15	2.15	1.75
October	1.52	1.47	3.20	2.35	2.42	2.05	2.15	1.75
November	1.50	1.40	3.28	2.35	2.35	2.00	2.15	1.77
December	1.50	1.37	3.53	2.35	2.25	2.00	2.00	1.88
Average	1.46	1.45	2.60	2.76	2.41	2.15	2.13	1.96

AVERAGE MONTHLY PRICES OF STEEL SHIP PLATES AT PITTSBURG.

The following table gives the average monthly prices, per long ton, of steel ship plates free on board at Pittsburg from October 1, 1900, to May 15, 1905:

Average monthly prices of steel ship plates at Pittsburg, Pa., from October 1, 1900, to May 15, 1905.

[Per long ton.]

Month.	Price.	Month.	Price.	Month.	Price.
1900.		1902.		1904.	
October	$24.64	May	$35.84	January	$35.84
November	28.00	June	35.84	February	35.84
December	30.24	July	35.84	March	35.84
1901.		August	35.84	April	35.84
January	31.36	September	35.84	May	35.84
February	31.36	October	35.84	June	35.84
March	33.15	November	35.84	July	35.84
April	35.84	December	35.84	August	35.84
May	35.84	1903.		September	32.48
June	35.84	January	35.84	October	31.36
July	35.84	February	35.84	November	31.36
August	35.84	March	35.84	December	32.37
September	35.84	April	35.84	1905.	
October	35.84	May	35.84	January	33.60
November	35.84	June	35.84	February	35.35
December	35.84	July	35.84	March	35.84
1902.		August	35.84	April	35.84
January	35.84	September	35.84	May 15	35.84
February	35.84	October	35.84		
March	35.84	November	35.84		
April	35.84	December	35.84		

The average annual price of steel ship plates at Pittsburg was $34.87 per long ton in 1901, $35.84 in 1902, $35.84 in 1903, and $34.52 in 1904.

AVERAGE QUARTERLY PRICES OF BEAMS AND CHANNELS AT PITTSBURG.

The average quarterly prices, per 100 pounds, of steel beams and channels at Pittsburg from 1894 to 1905 have been as follows:

Average quarterly prices of beams and channels at Pittsburg, 1894–1905.

[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	1.55	1.41	1.54
1899	1.35	1.60	2.12	2.25	1.83	1905	1.55	....	....	....	....

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. The highest average quarterly price was in the last quarter of 1899 and the first quarter of 1900, when it was $2.25 per 100 pounds.

AVERAGE MONTHLY PRICES OF DOMESTIC TIN PLATES.

The following table gives the average wholesale monthly prices of American Bessemer tin plates, I. C., 14 by 20, per box of 100 pounds, at mills in Pennsylvania, from 1901 to 1904, inclusive:

Average wholesale monthly prices of tin plates at mills in Pennsylvania, 1901–1904.

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	3.30
November	4.00	November	3.60	November	3.65	November	3.39
December	4.00	December	3.60	December	3.60	December	3.47
Average	4.00	Average	3.93	Average	3.74	Average	3.41

The average monthly price of tin plates at mills in Pennsylvania was $3.55 per box in January, 1905; $3.55 in February, $3.55 in March, $3.55 in April, and $3.55 in May.

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, inclusive:

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

In recent years tin plates have been imported chiefly by the oil and canning interests to obtain the benefit of the drawback.

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 1904, inclusive:

Average yearly prices of domestic tin plates, 1899–1904.

Year.	Price.	Year.	Price.	Year.	Price.
1899	$4.06	1901	$4.00	1903	$3.74
1900	4.47	1902	3.93	1904	3.41

TOTAL PRODUCTION OF PIG IRON.

Twenty States made pig iron in 1904, against 22 in 1903. The total production of pig iron in 1904 was 16,497,033 long tons, against 18,009,252 tons in 1903. The following table gives the half-yearly production of pig iron in the last six years:

Production of pig iron in the United States, 1899–1904, by half years.

[Long tons.]

Period.	1899.	1900.	1901.	1902.	1903.	1904.
First half	6,289,167	7,642,569	7,674,613	8,808,574	9,707,367	8,173,438
Second half	7,331,536	6,146,673	8,203,741	9,012,733	8,301,885	8,323,595
Total	13,620,703	13,789,242	15,878,354	17,821,307	18,009,252	16,497,033

The production of pig iron in 1904 was 1,512,219 tons less than in 1903. The last months of 1904 showed a steady increase.

The following table gives the production of pig iron by States in 1903 and 1904, in the order of their prominence in 1903:

Production of pig iron in 1903 and 1904, by States.

[Long tons.]

State.	1903.	1904.	State.	1903.	1904.
Pennsylvania	8,211,500	7,644,321	Michigan	244,709	233,225
Ohio	3,287,434	2,977,929	New Jersey	211,667	262,294
Illinois	1,692,375	1,655,991	West Virginia	199,013	270,945
Alabama	1,561,398	1,453,513	Kentucky	102,441	37,106
New York	552,917	605,709	North Carolina, Georgia	75,602	70,156
Virginia	544,034	310,526	Connecticut	14,501	8,922
Tennessee	418,368	302,096	Texas	11,653	5,530
Maryland	324,570	293,441	Massachusetts	3,265	3,149
Wisconsin, Minnesota	283,516	210,404	Total	18,009,252	16,497,033
Missouri, Colorado, Washington	270,289	151,776			

PRODUCTION OF PIG IRON ACCORDING TO FUEL.

The production of pig iron in 1904, classified according to the fuel used, was as follows, compared with the four preceding years:

Production of pig iron according to fuel used, 1900–1904.

[Long tons.]

Fuel used.	1900.	1901.	1902.	1903.	1904.
Bituminous, chiefly coke	11,727,712	13,782,386	16,315,891	15,592,221	14,931,364
Anthracite and coke mixed	1,636,366	1,668,808	1,096,040	1,864,199	1,196,867
Anthracite alone	40,682	43,719	19,207	47,148	31,273
Charcoal	339,874	360,147	378,504	504,757	337,529
Charcoal and coke	44,608	23,294	11,665	927	....
Total	13,789,242	15,878,354	17,821,307	18,009,252	16,497,033

PRODUCTION OF BESSEMER PIG IRON.

The production of Bessemer and low-phosphorus pig iron in 1904 amounted to 9,098,659 tons, against 9,989,908 tons in 1903. The following table gives the production of Bessemer pig iron by States in each year from 1899 to 1904. Bessemer pig iron made with charcoal is included. Low-phosphorus pig iron is included for 1901, 1902, 1903, and 1904, but not for 1899 and 1900.

Production of Bessemer pig iron in 1899–1904, by States.

[Long tons.]

State.	1899.	1900.	1901.	1902.	1903.	1904.
Pennsylvania	4,473,493	4,242,397	4,885,877	5,130,022	5,213,143	4,511,999
Ohio	1,852,965	1,898,663	2,637,091	2,927,605	2,122,676	2,138,442
Illinois	1,330,169	1,178,241	1,394,430	1,495,298	1,386,683	1,424,030
Maryland	210,670	260,688	297,149	296,971	321,784	292,642
West Virginia, North Carolina	187,858	169,802	166,597	182,937	198,688	267,505
Colorado	96,364	118,146	147,216	201,580	176,116	112,318
Kentucky, Tennessee	22,756	13,430	....	9,746	26,856	25,209
Wisconsin, Michigan, Minnesota	14,519	21,785	39,941	82,328	111,340	76,031
New Jersey	13,984	40,300 (New Jersey, New York)	28,492	66,681	129,323	250,483
New York	....					
Virginia, Alabama	....	....	....	....	3,299	....
Total	8,202,778	7,943,452	9,596,793	10,393,168	9,989,908	9,098,659

Of the production of Bessemer and low-phosphorus pig iron in Pennsylvania in 1904 the Lehigh Valley made 64,494 tons; the Schuylkill Valley, 38,973 tons; the lower Susquehanna Valley, 255,091 tons;

Allegheny County, 2,975,596 tons; the Shenango Valley, 752,238 tons; and the remainder of the State, 425,607 tons; total, 4,511,999 tons.

In Ohio in 1904 the Mahoning Valley produced 914,445 tons of Bessemer and low-phosphorus pig iron; the Hanging Rock bituminous district, 101,656 tons; the lake counties, 596,932 tons; and other parts of Ohio, 525,409 tons; total, 2,138,442 tons.

PRODUCTION OF BASIC PIG IRON.

The production of basic pig iron in 1904, not including charcoal pig iron of basic quality, was 2,483,104 tons, against 2,040,726 tons in 1903, an increase of 442,378 tons. The production of basic pig iron, by States, since 1900 is given in the following table:

Production of basic pig iron, 1900–1904, by States

[Long tons.]

State.	1900.	1901.	1902.	1903.	1904.
New York and New Jersey	4,929	34,320	90,736	117,802	113,688
Pennsylvania, Allegheny County	446,543	568,516	932,532	791,175	1,245,142
Pennsylvania, other counties	344,065	442,744	596,216	626,078	560,605
Virginia, Tennessee, and Alabama	179,717	301,444	295,191	267,999	319,329
Ohio, Illinois, Wisconsin, Missouri, and Colorado	97,122	101,826	123,915	237,672	244,340
Total	1,072,376	1,448,850	2,038,590	2,040,726	2,483,104

Maryland, Tennessee, Illinois, and Wisconsin did not make basic pig iron in 1901 or 1902, as in some previous years, and Maryland and Wisconsin did not make any in 1903 or 1904. Colorado made basic pig iron for the first time in 1903, but was not a producer in 1904.

A significant feature of these statistics is the increased production of basic pig iron in 1904, a year of generally reduced production. In the same year the production of Bessemer pig iron declined 891,249 tons as compared with the production in 1903.

PRODUCTION OF SPIEGELEISEN, FERROMANGANESE, AND FERROPHOSPHORUS.

The production of spiegeleisen, ferromanganese, and ferrophosphorus in 1904, included in the total production of pig iron, was 220,392 tons, against 192,661 tons in 1903. The production of ferromanganese alone in 1904 amounted to 57,076 tons, against 35,961 tons in 1903, and of spiegeleisen alone to 162,370 tons, against 156,700 tons in 1903. The spiegeleisen and ferromanganese produced in 1904 were made by New Jersey, Pennsylvania, Illinois, and Colorado. Tennessee was the only State which made ferrophosphorus in 1904, its production amounting to 946 tons, all made by one company. In 1903 no ferrophosphorus was reported by pig-iron manufacturers.

PRODUCTION OF PIG IRON IN PENNSYLVANIA, BY DISTRICTS.

The production of pig iron in Pennsylvania, by districts, in 1904 was as follows: Lehigh Valley, 456,028 tons; Schuylkill Valley, 409,416 tons; lower Susquehanna Valley, 397,156 tons; Juniata Valley, 120,471 tons; Allegheny County, 4,383,169 tons; Shenango Valley, 1,011,440 tons; western Pennsylvania, except Allegheny County and the Shenango Valley, 864,048 tons; charcoal (whole State), 2,593 tons; total, 7,644,321 tons. Pig iron was not made in the upper Susquehanna Valley in 1903 or 1904.

In 1904 the Shenango Valley lowered its output 126,721 tons as compared with 1903; Allegheny County increased its production 171,600 tons; western Pennsylvania, outside of Allegheny County and the Shenango Valley, decreased 62,966 tons; the Lehigh Valley lost 192,793 tons; the Schuylkill Valley lost 141,144 tons; the lower Susquehanna Valley lost 100,450 tons; the Juniata Valley lost 113,228 tons; and charcoal lost 1,477 tons.

In 1901, 1902, and 1903 Allegheny County made a little more than one-half the production of Pennsylvania but less than one-fourth the country's total production. In 1904 it made 57.3 per cent of the total production of Pennsylvania and over 26 per cent of the country's total production.

In each of the years 1902 and 1903 Pennsylvania made 45.5 per cent of the country's total production of pig iron, and in 1904 it made a little over 46.3 per cent.

PRODUCTION OF PIG IRON IN OHIO, BY DISTRICTS.

The production of pig iron in Ohio in 1904, by districts, was as follows: Mahoning Valley, including the furnaces at Leetonia, 1,217,186 tons; Hocking Valley, 17,600 tons; lake counties, 807,257 tons; miscellaneous bituminous, 687,601 tons; Hanging Rock bituminous, 247,297 tons; Hanging Rock charcoal, 988 tons; total, 2,977,929 tons.

The decrease in production in the Mahoning Valley, including the furnaces at Leetonia, in 1904 compared with 1903 was 46,773 tons; in the lake counties the decrease was 21,647 tons; in the miscellaneous bituminous district it was 142,851 tons; in the Hanging Rock bituminous district it was 80,382 tons; in the Hanging Rock charcoal district it was 8,552 tons; and in the Hocking Valley it was 9,300 tons.

Of the country's total production in 1904 Ohio made a little over 18 per cent, almost the same percentage as in 1903.

PRODUCTION IN THE SHENANGO AND MAHONING VALLEYS.

The production of pig iron in the Mahoning Valley, in Ohio, which includes the furnaces at Leetonia, and in the Shenango Valley, in

Pennsylvania, in 1898 was almost exactly the same, the former producing 769,334 tons and the latter 769,677 tons. In 1899 the Mahoning Valley made 932,165 tons and the Shenango Valley made 937,215 tons. In 1900 the Mahoning Valley went away ahead of its rival, making 1,002,362 tons, against 800,214 tons in the Shenango Valley. In 1901 the Mahoning Valley further increased its lead, producing 1,404,857 tons, against 979,875 tons in the Shenango Valley. In 1902 the Mahoning Valley increased its production to 1,438,087 tons, while the Shenango Valley jumped to 1,254,933 tons, the gain in the Mahoning Valley amounting only to 33,230 tons, while the Shenango Valley increased its production 275,058 tons, showing a comparative gain of 241,828 tons in favor of the Shenango Valley, although the Mahoning Valley was still 183,154 tons in the lead. In 1903 the Mahoning Valley produced 1,263,959 tons and the Shenango Valley produced 1,138,161 tons, a decrease as compared with 1902 of 174,128 tons in the Mahoning Valley and of 116,772 tons in the Shenango Valley. In this year the Mahoning Valley led its rival by 125,798 tons. In 1904 the production in the Mahoning Valley fell to 1,217,186 tons, a loss as compared with 1903 of 46,773 tons. In the Shenango Valley the production also declined in 1904, falling to 1,011,440 tons, a loss of 126,721 tons. In that year the gain in the Mahoning Valley over its Pennsylvania rival amounted to 205,746 tons.

STOCKS OF UNSOLD PIG IRON.

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 and which had not been sold. The stocks of pig iron which were unsold in the hands of manufacturers, or which were under their control in warrant yards and elsewhere at the close of 1904, and were not intended for their own consumption, amounted to 408,792 tons, against 623,254 tons on June 30, 1904, and 591,438 tons on December 31, 1903. Warrant stocks not controlled by the makers are not included. The American Pig Iron Storage Warrant Company held 55,350 tons of pig iron in its yards on December 31, 1904, of which 17,700 tons, included above, were reported to us as being still controlled by the makers, leaving 37,650 tons in other hands. Adding this 37,650 tons to the 408,792 tons noted above gives us a total of 446,442 tons that were on the market at the close of 1904, against 598,489 tons in 1903, 49,951 tons in 1902, 73,647 tons in 1901, and 446,020 tons in 1900.

NUMBER OF COMPLETED FURNACES.

The whole number of completed furnaces in the United States at the close of 1904 was 429, against 425 at the close of 1903. The following table shows the number of furnaces at the end of each year since 1899, not counting abandoned furnaces:

Number of completed furnaces, 1899–1904, according to fuel used.

Fuel used.	1899.	1900.	1901.	1902.	1903.	1904.
Bituminous coal and coke	235	240	257	272	288	300
Anthracite and anthracite and coke mixed	99	94	90	81	77	73
Charcoal and charcoal and coke mixed	80	72	59	59	60	56
Total	414	406	406	412	425	429

During the first six months of 1904 the number of furnaces actually in blast during a part or the whole of the period was 295, and during the last half of the year the number was 297.

FURNACES IN BLAST IN THE LAST SIX YEARS.

The whole number of furnaces in blast on December 31, 1904, was 261, against 216 on June 30, 1904, and 182 on December 31, 1903. The number of furnaces in blast at the end of 1904 was 45 larger than on June 30 of the same year and 79 larger than on December 31, 1903. The number of furnaces out of blast at the close of 1904 was 168, as compared with 243 at the end of 1903. The following table shows the number of furnaces in blast at the close of each year since 1899:

Number of furnaces in blast, 1899–1904, according to fuel used.

Fuel used.	1899.	1900.	1901.	1902.	1903.	1904.
Bituminous coal and coke	191	155	188	222	120	206
Anthracite and anthracite and coke mixed	68	45	54	52	29	38
Charcoal and charcoal and coke mixed	30	32	24	33	33	17
Total	289	232	266	307	182	261

ANNUAL CONSUMPTION OF PIG IRON.

The consumption of pig iron in the last five years is approximately shown in the following table. Warrant stocks not controlled by the makers are included in unsold stocks for each year.

Annual consumption of pig iron in the United States, 1900–1904.

[Long tons.]

	1900.	1901.	1902.	1903.	1904.
Domestic production	13,789,242	15,878,354	17,821,307	18,009,252	16,497,033
Imported	52,565	62,930	619,354	599,574	79,500
Stocks unsold Jan. 1	68,309	446,020	73,647	49,951	598,489
Total supply	13,910,116	16,387,304	18,514,308	18,658,777	17,175,022
Deduct stocks Dec. 31	446,020	73,647	49,951	598,489	446,442
Also exports	286,687	81,211	27,487	20,379	49,025
Approximate consumption	13,177,409	16,232,446	18,436,870	18,039,909	16,679,555

Although the production of pig iron in 1904 fell below that of 1903 by 1,512,219 tons, the consumption in 1904 was only 1,360,354 tons less than in 1903, the stocks of unsold pig iron at the close of 1904 being 152,047 tons less than at the close of 1903, while imports of pig iron greatly declined in 1904.

LIMESTONE CONSUMED IN MAKING PIG IRON.

The limestone consumed for fluxing purposes by the blast furnaces of the United States in the production of 16,497,033 tons of pig iron in 1904 amounted to 8,195,036 long tons. The average consumption of limestone per ton of all kinds of pig iron produced was 1,112.6 pounds in 1904, against 1,193 pounds in 1903, 1,192.8 pounds in 1902, 1,186.5 pounds in 1901, and 1,205.6 pounds in 1900. The consumption in 1904 by the anthracite and bituminous furnaces was 1,128 pounds per ton of pig iron made, and by the charcoal furnaces it was 373.6 pounds.

PRODUCTION OF PIG IRON BY GRADES.

The following table gives the total production of pig iron in the United States in 1900, 1901, 1902, 1903, and 1904, by grades. Prior to 1900 the production of all grades was not ascertained. 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 and 1904.

Production of pig iron in 1900-1904, by grades.

[Long tons.]

Grade.	1900.	1901.	1902.	1903.	1904.
Bessemer and low phosphorus	7,979,327	9,596,793	10,393,168	9,989,908	9,098,659
Basic (mineral fuel)	1,072,376	1,448,850	2,038,590	2,040,726	2,483,104
Forge pig iron	793,092	639,454	833,093	783,016	550,836
Foundry and high silicon	3,376,445	3,548,718	3,851,276	4,409,023	3,827,229
Malleable Bessemer	173,413	256,532	311,458	473,781	263,529
White and mottled and miscellaneous	129,909	87,964	172,085	120,137	53,284
Spiegeleisen	207,505	231,822	168,408	156,700	162,370
Ferromanganese	48,472	59,639	44,573	35,961	58,022
Direct castings	8,703	8,582	8,656	....	....
Total	13,789,242	15,878,354	17,821,307	18,009,252	16,497,033

Of the total production of pig iron in 1904 over 55.1 per cent was Bessemer and low phosphorus, as compared with over 55.4 per cent in 1903; nearly 23.2 per cent was foundry, against 24.4 per cent in 1903; 15 per cent was basic, against over 11.3 per cent in 1903; 3.3 per cent was forge; 1.3 per cent was spiegeleisen and ferromanganese; and almost 1.6 per cent was malleable Bessemer. White and mottled and miscellaneous grades and furnace castings did not amount to 1 per cent in 1903 and 1904.

Included in the 3,827,229 tons of foundry pig iron made in 1904 are 69,730 tons of ferrosilicon, made in Pennsylvania, Virginia, West Virginia, Kentucky, and Ohio, a small part of which was made with electricity. In 1903, 51,516 tons of ferrosilicon were made. Pig iron containing 7 per cent of silicon and over is classified as ferrosilicon. Virtually all the charcoal iron made is classified as foundry pig iron. Alabama is now the leading producer of foundry pig iron and Pennsylvania of forge pig iron.

PRODUCTION OF BESSEMER STEEL.

The total production of Bessemer steel ingots and castings in the United States in 1904 was 7,859,140 long tons, against 8,592,829 tons in 1903, a decrease of 733,689 tons, or 8.5 per cent. The production in 1903 was 545,534 tons less than in 1902, in which year the production was the largest in the history of the country.

The following table gives the production of Bessemer steel ingots and castings in the last five years by States. Of the production in 1904, 16,051 tons were direct castings, against a similar production of 18,099 tons in 1903 and 12,548 tons in 1902.

Production of Bessemer steel in the United States, 1900–1904, by States.

[Long tons.]

State.	1900.	1901.	1902.	1903.	1904.
Pennsylvania	3,488,731	4,293,439	4,209,326	3,909,436	3,464,650
Ohio	1,388,124	2,154,846	2,528,802	2,330,134	2,050,115
Illinois	1,115,571	1,324,217	1,443,614	1,366,569	1,257,190
Other States	692,344	940,800	956,621	986,690	1,087,185
Total	6,684,770	8,713,302	9,138,363	8,592,829	7,859,140

There were no Clapp-Griffiths works in operation in 1904 and only 2 Robert-Bessemer plants were active. Eleven Tropenas plants were at work, as compared with 8 in 1903. In addition 2 plants made steel by the Bookwalter process and 5 plants in special converters. With the exception of the Clapp-Griffiths plant all these works make a specialty of steel castings.

The following table gives separately the production of Bessemer steel ingots and castings from 1898 to 1904, all made by the acid process. Prior to 1898 Bessemer castings were included with ingots. Basic Bessemer steel has not been made in this country since 1897, when about 69,000 tons of ingots were produced at Troy, New York, by the Troy Steel Company.

Production of Bessemer ingots and castings, 1898–1904.

[Long tons.]

Year.	Ingots.	Castings.	Total.
1898	6,605,478	3,539	6,609,017
1899	7,582,415	3,939	7,586,354
1900	6,678,303	6,467	6,684,770
1901	8,706,538	6,764	8,713,302
1902	9,125,815	12,548	9,138,363
1903	8,574,730	18,099	8,592,829
1904	7,843,089	16,051	7,859,140

NEW BESSEMER STEEL CASTING PLANTS.

No new standard Bessemer plants were built in 1904. Nor was work commenced on any new standard Bessemer plants during that year. A number of works to make steel by the Tropenas process were, however, completed and put in operation in 1904; also one plant to make steel by the Bookwalter process and one plant to make steel in a special Bessemer converter.

The new Tropenas plants which were built and put in operation in 1904 were as follows: Watertown Arsenal, Watertown, Mass., one 2-long-ton converter, first steel made March 25, 1904; Massachusetts Steel Casting Company, Everett, Mass., one 2-long-ton converter, first steel made December 29, 1904; Providence Steel Casting Company, Providence, R. I., one 2-long-ton converter, first steel made in May, 1904; foundations are now ready for an additional 2-long-ton converter, which may be completed in 1905. United States navy-yard, Brooklyn, N. Y., one 2-long-ton converter, first steel made December 19, 1904; Southern Steel Works, Chattanooga, Tenn., one 2-long-ton converter, first steel made December 1, 1904. In addition to the above, Isaac G. Johnson & Co., (Incorporated), of Spuyten Duyvil, N. Y., added one 2-long-ton Tropenas converter to its plant in the summer of 1904, and its works are now equipped with two 2-long-ton converters.

The new plant to make steel by the Bookwalter process was erected by the Brylgon Steel Casting Company, at Newcastle, Del. It is equipped with two 2-long-ton converters. Steel was first made on September 22, 1904. The plant to make steel in a special converter was built by the Milwaukee Steel Foundry Company, at Milwaukee, Wis. Steel was first made on March 15, 1904. The converter has a capacity of 1 ton at each blow.

All the plants enumerated above make a specialty of steel castings, although occasionally a few ingots are made. Some of these ingots are used in the production of forgings.

PRODUCTION OF OPEN-HEARTH STEEL.

The total production of open-hearth steel ingots and direct castings in the United States in 1904 was 5,908,166 long tons, against 5,829,911 tons in 1903, an increase of 78,255 tons, or over 1.3 per cent. While this increase was not so great as had been looked for, it should be remembered that any increase at all in a year which witnessed a general reaction in business, and especially in the iron trade, marks an important advance in the open-hearth branch of our iron and steel industries.

The following table gives the production of open-hearth steel ingots and castings, by States, since 1899, in long tons:

Production of open-hearth steel ingots and castings in the United States, 1899–1904, by States.

[Long tons.]

State.	1899.	1900.	1901.	1902.	1903.	1904.
New England	57,124	74,522	170,876	179,923	169,209	195,901
New York and New Jersey	61,461	67,361	82,985	92,763	104,598	165,986
Pennsylvania	2,393,811	2,699,502	3,594,763	4,375,364	4,442,730	4,306,498
Ohio	117,458	130,191	184,943	278,854	369,349	480,906
Illinois	246,183	285,551	398,522	435,461	422,919	358,215
Other States	71,279	141,008	224,220	325,364	321,106	400,660
Total	2,947,316	3,398,135	4,656,309	5,687,729	5,829,911	5,908,166

The open-hearth steel made in 1904, including both ingots and castings, was produced by 116 works in 16 States—Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Maryland, Tennessee, Alabama, Ohio, Indiana, Illinois, Wisconsin, Missouri, Colorado, and California. One hundred and eleven works in 17 States made open-hearth steel in 1903, and 98 works in 16 States made open-hearth steel in 1902.

The production of open-hearth steel ingots in 1904, excluding castings, the latter to be noticed hereafter, amounted to 5,605,332 long tons, against 5,429,563 long tons in 1903, an increase of 175,769 long tons.

PRODUCTION OF BASIC AND ACID OPEN-HEARTH STEEL INGOTS AND CASTINGS.

In the following table is given the production, by States, of both basic and acid open-hearth steel ingots and castings in 1904. The production of open-hearth steel by the basic and acid processes was first separately ascertained by the American Iron and Steel Association for the year 1896.

Production of basic and acid open-hearth steel ingots and castings in the United States in 1904, by States.

[Long tons.]

State.	Basic open-hearth steel.	Acid open-hearth steel.	Total.
New England	147,390	48,511	195,901
New York and New Jersey	139,791	26,195	165,986
Pennsylvania	3,667,673	638,825	4,306,498
Ohio	427,948	52,958	480,906
Illinois	341,073	17,142	358,215
Other States	382,492	18,168	400,660
Total for 1904	5,106,367	801,799	5,908,166
Total for 1903	4,734,913	1,094,998	5,829,911
Total for 1902	4,496,533	1,191,196	5,687,729
Total for 1901	3,618,993	1,037,316	4,656,309
Total for 1900	2,545,091	853,044	3,398,135
Total for 1899	2,080,426	866,890	2,947,316
Total for 1898	1,569,412	660,880	2,230,292
Total for 1897	1,056,043	552,628	1,608,671
Total for 1896	776,256	522,444	1,298,700

In 1903 4,734,913 tons of open-hearth steel were made by the basic process and 1,094,998 tons were made by the acid process, while in 1904 the production by the basic process amounted to 5,106,367 tons and by the acid process to 801,799 tons. A loss in production by the acid process in 1904 of 293,199 tons is indicated by these figures, but they also show a gain of 371,454 tons in the production of basic steel. This gain is less than the gain of 442,378 tons in 1904 in the production of basic pig iron. 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. These figures show a steady decline in the production of acid steel.

PRODUCTION OF OPEN-HEARTH STEEL INGOTS AND CASTINGS.

The following table gives separately the total production of open-hearth steel ingots and castings from 1898 to 1904:

Production of open-hearth steel ingots and castings, 1898–1904.

[Long tons.]

Year.	Ingots.	Castings.	Total.
1898	2,109,705	120,587	2,230,292
1899	2,777,587	169,729	2,947,316
1900	3,220,644	177,491	3,398,135
1901	4,354,687	301,622	4,656,309
1902	5,319,850	367,879	5,687,729
1903	5,429,563	400,348	5,829,911
1904	5,605,332	302,834	5,908,166

PRODUCTION OF BASIC AND ACID OPEN-HEARTH STEEL INGOTS.

The following table gives the production of basic and acid open-hearth steel ingots in the United States from 1898 to 1904, direct castings being omitted. A table giving the production of basic and acid open-hearth steel castings will be found on this page.

Production of basic and acid open-hearth steel ingots, 1898–1904.

[Long tons.]

Year.	Basic open-hearth ingots.	Acid open-hearth ingots.	Total.
1898	1,540,952	568,753	2,109,705
1899	2,040,737	736,850	2,777,587
1900	2,502,447	718,197	3,220,644
1901	3,524,052	830,635	4,354,687
1902	4,384,129	935,721	5,319,850
1903	4,600,034	829,529	5,429,563
1904	5,007,448	597,884	5,605,332

PRODUCTION OF BASIC AND ACID OPEN-HEARTH STEEL CASTINGS.

The total production of open-hearth steel castings in 1904, as already stated, amounted to 302,834 long tons, of which 98,919 tons were made by the basic process and 203,915 tons were made by the acid process. In 1903 the production of open-hearth steel castings amounted to 400,348 tons, of which 134,879 tons were made by the basic process and 265,469 tons by the acid process. The decrease in the production of castings in 1904, as compared with 1903, amounted to 97,514 tons, the decline in basic castings amounting to 35,960 tons and in acid castings to 61,554 tons.

The production of open-hearth steel castings was first separately ascertained by the American Iron and Steel Association for the year 1898. The following table gives the production by States in each year since this separation was made:

Production of basic and acid open-hearth steel castings in 1904, by States.

[Long tons.]

State.	Basic castings.	Acid castings.	Total.
New England, New York, and New Jersey	17,193	27,285	44,478
Pennsylvania	5,831	128,579	134,410
Ohio, Indiana, Illinois, and other States	75,895	48,051	123,946
Total for 1904	98,919	203,915	302,834
Total for 1903	134,879	265,469	400,348
Total for 1902	112,404	255,475	367,879
Total for 1901	94,941	206,681	301,622
Total for 1900	42,644	134,847	177,491
Total for 1899	39,689	130,040	169,729
Total for 1898	28,460	92,127	120,587

In addition to the States named in the table Massachusetts, Connecticut, Tennessee, Alabama, Wisconsin, Missouri, and California made open-hearth steel castings in 1904.

The following table gives the production of open-hearth steel castings, by States, since 1898:

Production of open-hearth steel castings, 1898–1904, by States.

[Long tons.]

State.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
New England, New York, and New Jersey	14,657	21,640	21,883	37,154	37,041	36,094	44,478
Pennsylvania	47,270	69,996	78,584	108,486	152,399	182,021	134,410
Ohio, Indiana, Illinois, and other States	58,660	78,093	77,024	155,982	178,439	182,233	123,946
Total	120,587	169,729	177,491	301,622	367,879	400,348	302,834

PRODUCTION OF CRUCIBLE STEEL.

The production of crucible steel in the United States in 1904 amounted to 83,391 long tons, against 102,434 tons in 1903, a decrease of 19,043 tons, or 18.5 per cent. Eight States made crucible steel in 1904, namely, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Indiana, Illinois, and Wisconsin. The direct castings produced in 1904, included above, amounted to 4,308 tons, against 5,409 tons in 1903. Pennsylvania made 60,815 tons of crucible steel ingots and castings in 1904, against 75,437 tons in 1903. No other State made over 8,500 tons in 1904 or 10,500 tons in 1903. With the exception of New Jersey, all the States named made crucible steel castings as well as ingots in 1904.

The following table gives separately the production of crucible steel ingots and castings from 1898 to 1904, in long tons:

Production of crucible steel ingots and castings, 1898–1904.

[Long tons.]

Year.	Ingots.	Castings.	Total.
1898	85,512	4,235	89,747
1899	97,713	3,500	101,213
1900	96,573	3,989	100,562
1901	94,586	3,927	98,513
1902	107,817	4,955	112,772
1903	97,025	5,409	102,434
1904	79,083	4,308	83,391

PRODUCTION OF MISCELLANEOUS STEEL.

The production of steel in the United States in 1904 by various minor processes amounted to 9,190 long tons, against 9,804 tons in

1903. Three States made steel in 1904 by minor processes, namely, New Jersey, Pennsylvania, and Indiana. 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 1904 amounted to 13,859,887 long tons, against 14,534,978 tons in 1903, a decrease of 675,091 tons, or over 4.6 per cent, and against 14,947,250 tons in 1902. Of the total production in 1904, 13,529,676 tons were ingots and 330,211 were direct castings. The maximum production of steel ingots and castings was reached in 1902; the year of next highest production was 1903. Puddled, "patented," and all other kinds of steel are included.

PRODUCTION OF ALL KINDS OF RAILS.

The production of all kinds of rails in 1904 amounted to 2,284,711 long tons, against 2,992,477 tons in 1903, a decrease of 707,766 tons, or 23.6 per cent. The production in 1902 was 2,947,933 tons. In the following table the production of all kinds of rails in 1904 is given by States.

Production of all kinds of rails in 1904, by States.

[Long tons.]

State.	Bessemer.	Open-hearth.	Iron.	Total.
Pennsylvania	801,657	20,451	....	822,108
Other States	1,336,300	125,432	871	1,462,603
Total	2,137,957	145,883	871	2,284,711

Twenty-six plants in 13 States rolled or rerolled rails in 1904, as follows: New York, 2; Pennsylvania, 5; Maryland, 3; West Virginia, 2; Tennessee, 1; Georgia, 1; Alabama, 3; Ohio, 3; Illinois, 2; Wisconsin, 1; Kansas, 1; Colorado, 1; and Wyoming, 1. The year of maximum production of all kinds of rails was 1903; the year of next largest production was 1902.

PRODUCTION OF BESSEMER STEEL RAILS.

The production of Bessemer steel rails in 1904 amounted to 2,137,957 long tons, against 2,946,756 tons in 1903, a decrease of 808,799 tons, or over 27.4 per cent. The maximum production of Bessemer steel rails was reached in 1903. In the following table the production of Bessemer steel rails is given by States from 1899 to 1904. Rails rolled from purchased blooms, crop ends, and "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 Bessemer steel rails, 1899-1904, by States.

[Long tons.]

Bessemer steel rails.	1899.	1900.	1901.	1902.	1903.	1904.
Pennsylvania	1,224,807	1,195,255	1,406,008	1,148,425	1,186,284	801,657
Other States	1,045,778	1,188,399	1,464,808	1,786,967	1,760,472	1,336,300
Total	2,270,585	2,383,654	2,870,816	2,935,392	2,946,756	2,137,957

In addition to Pennsylvania the States which made Bessemer rails in 1904 were New York, Maryland, West Virginia, Georgia, Ohio, Illinois, Wisconsin, Kansas, Colorado, and Wyoming.

The production of Bessemer steel rails by the makers of Bessemer steel ingots, included above, amounted to 2,084,688 long tons in 1904, 2,873,228 tons in 1903, 2,876,293 tons in 1902, 2,836,273 tons in 1901, 2,361,921 tons in 1900, and 2,240,767 tons in 1899. In the following table we give the total production of all kinds of Bessemer steel rails from 1899 to 1904, the rails rolled by makers of domestic ingots being separated from those rolled by companies which did not operate Bessemer converters.

Production of all kinds of Bessemer steel rails, 1899-1904.

[Long tons.]

Bessemer steel rails.	1899.	1900.	1901.	1902.	1903.	1904.
By makers	2,240,767	2,361,921	2,836,273	2,876,293	2,873,228	2,084,688
By all others	29,818	21,733	34,543	59,099	73,528	53,269
Total	2,270,585	2,383,654	2,870,816	2,935,392	2,946,756	2,137,957

Twenty-two plants rolled or rerolled Bessemer steel rails in 1904, of which 5 were located in Pennsylvania, 3 in Maryland, 2 in West Virginia, 3 in Ohio, 2 in Illinois, 2 in New York, and 1 each in Georgia, Wisconsin, Kansas, Colorado, and Wyoming.

PRODUCTION OF OPEN-HEARTH AND IRON RAILS.

The total production of open-hearth steel rails in the United States in 1904 was 145,883 long tons, against 45,054 tons in 1903, 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 1904. Prior to 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 made in 1904, Pennsylvania and Colorado being the only other producers. Over 116,000 tons of the open-hearth rails made weighed between 45 and 85 pounds per yard and over 8,000 tons weighed 85 pounds or over; the remainder, over 21,000 tons, weighed less than 45 pounds.

The production of iron rails in 1904 was 871 tons, all rolled in Tennessee and Alabama, and all weighing less than 45 pounds to the yard. In 1903 the production of iron rails was 667 tons, against 6,512 tons in 1902, 1,730 tons in 1901, 695 tons in 1900, 1,592 tons in 1899, and 3,319 tons in 1898. The maximum production of iron rails was reached in 1872, 808,866 tons.

WEIGHT OF ALL KINDS OF RAILS.

The production of rails weighing under 45 pounds to the yard in 1904 shows an increase of 70,621 tons as compared with 1903, but the production of rails weighing 45 pounds and less than 85 pounds shows a decrease of 282,411 tons as compared with 1903. The great falling off in the production of rails in 1904 as compared with 1903 was, however, in sections weighing 85 pounds and over to the yard, in which the decrease amounted to 495,976 tons.

The following table gives the production of all kinds of rails in 1904, according to the weight of the rails per yard. Street rails are included in the total production of rails. Prior to 1897 the weight per yard of rails produced was not ascertained by the American Iron and Steel Association.

Production of all kinds of rails in United States, 1897–1904, 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	269,743	1,204,356	663,858	2,137,957
Open-hearth steel rails	21,269	116,321	8,293	145,883
Iron rails	871			871
Total for 1904	291,883	1,320,677	672,151	2,284,711
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

In addition to the rails rolled, 37,776 tons of iron and steel rails were imported in 1904. During the same year 416,250 tons were exported. In 1903 the exports of rails amounted to 30,837 tons and the imports to 95,555 tons. Virtually all the imports and exports of rails are steel rails.

PRODUCTION OF STRUCTURAL SHAPES.

The 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.

The total production of strictly structural shapes in 1904 was 949,146 long tons, against 1,095,813 tons in 1903, a decrease of 146,667 tons. Of the total production in 1904, about 941,127 tons were rolled from steel and about 8,019 tons from iron. The production of structural shapes in 1903 and 1904, by States, was as follows:

Production of iron and steel structural shapes in United States in 1903 and 1904, by States.

[Long tons.]

State.	1903.	1904.
New York and New Jersey	32,884	47,657
Pennsylvania	1,004,375	829,167
Delaware, Alabama, and Ohio	34,191	24,284
Indiana, Illinois, Wyoming, and California	24,363	48,038
Total	1,095,813	949,146

Pennsylvania made over 87.3 per cent of the total production in 1904, against over 91 per cent in 1903; New Jersey over 4.3 per cent, against over 3 per cent in 1903; and Indiana over 3.1 per cent, against less than 1 per cent in 1903. No other State made 2.6 per cent in 1904 or 3 per cent in 1903.

PRODUCTION OF WIRE RODS.

The production of iron and steel wire rods in the United States in 1904 amounted to 1,699,028 long tons, against 1,503,455 tons in 1903, 1,574,293 tons in 1902, 1,365,934 tons in 1901, and 846,291 tons in 1900, showing an increase of 195,573 tons in 1904 as compared with 1903, or over 13 per cent. Of the total production in 1904, 1,697,862 tons were steel rods and 1,166 tons were iron rods. In 1903 the steel wire rods rolled amounted to 1,503,425 tons and the iron rods to 30 tons. The maximum production was reached in 1904. The following table gives the total production of iron and steel wire rods, by States, in the last four years:

Production of wire rods in United States, 1901–1904, by States.

[Long tons.]

State.	1901.	1902.	1903.	1904.
Massachusetts, Connecticut, Rhode Island, New York, and New Jersey	176,101	201,653	240,024	228,289
Pennsylvania, Kentucky, Alabama, and Ohio	808,716	950,260	897,891	973,801
Indiana, Illinois, and Colorado	381,117	422,380	365,540	496,938
Total	1,365,934	1,574,293	1,503,455	1,699,028

Pennsylvania made the largest quantity of wire rods in 1904, with Illinois second, Ohio third, and Massachusetts fourth. Eight other States—Indiana, Colorado, Kentucky, New York, New Jersey, Connecticut, Alabama, and Rhode Island—also rolled wire rods in 1904 in the order named. All the States mentioned also rolled iron or steel wire rods in 1903.

PRODUCTION OF WIRE NAILS.

The production of wire nails in the United States in 1904 amounted to 11,926,661 kegs of 100 pounds, as compared with 9,631,661 kegs in 1903, an increase of 2,295,000 kegs. The following table gives the production of wire nails, by States, in 1902, 1903, and 1904, in kegs of 100 pounds.

Production of wire nails in United States, 1902–1904, by States.

[Kegs of 100 pounds.]

State.	1902.	1903.	1904.
New Hampshire, Massachusetts, Rhode Island, and Connecticut.	309,651	230,264	247,157
New York, New Jersey, Pennsylvania, Ohio, and Alabama	7,345,483	6,540,452	7,791,661
Maryland, West Virginia, Kentucky, Indiana, and Illinois	3,160,899	2,525,474	3,236,120
Michigan, Wisconsin, Colorado, and California	166,213	335,471	651,723
Total	10,982,246	9,631,661	11,926,661

The wire nails produced in 1904 were all made of steel, and were turned out by 56 works, as compared with 57 in 1903, 62 in 1902, 61 in 1901, 56 in 1900, and 59 in 1899. For 1903 it was necessary to estimate the production of two wire nail plants and for 1904 to estimate the production of one plant. The maximum production of wire nails was reached in 1904.

PRODUCTION OF CUT NAILS.

The 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 forged spikes, 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 spikes cut from plates in 1904 was 1,283,362 kegs of 100 pounds each, against 1,435,893 kegs in 1903, a decrease of 152,531 kegs. In 1886 the maximum production of 8,160,973 kegs was reached. In 1904 the production of wire nails exceeded that of cut nails by 10,643,299 kegs, in 1903 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, and in 1898 by 5,846,254 kegs.

Eleven States made cut nails in 1904 and 11 in 1903. The following table gives the production of iron and steel cut nails by States from 1899 to 1904, in kegs of 100 pounds. The wire-nail production is added to the table. Except West Virginia and Kentucky all the States which produced cut nails in 1904 decreased their production as compared with 1903. Of the total production of cut nails in 1904 about 887,675 kegs were made from steel plates and about 395,687 kegs from iron plates.

Production of cut nails in the United States, 1899–1904, by States.

[Kegs of 100 pounds.]

State.	1899.	1900.	1901.	1902.	1903.	1904.
Pennsylvania	920,133	777,611	833,469	752,729	725,000	698,326
Ohio	386,215	261,216	123,788	99,938	59,240	54,038
West Virginia and Indiana	178,006	168,469	150,222	271,362	274,808	245,997
Massachusetts and New Jersey	149,700	155,968	179,474	167,963	143,898	128,943
Illinois, Maryland, Virginia, and Kentucky	255,286	193,230	240,657	304,990	223,447	148,058
Wisconsin, Colorado, and California	15,000	17,000	14,630	36,780	9,500	8,000
Total cut nails	1,904,340	1,573,494	1,542,240	1,633,762	1,435,893	1,283,362
Total wire nails	7,618,130	7,233,979	9,803,822	10,982,246	9,631,661	11,926,661
Grand total	9,522,470	8,807,473	11,346,062	12,616,008	11,067,554	13,210,023

PRODUCTION OF PLATES AND SHEETS.

The production of iron and steel plates and sheets in the United States in 1904, excluding nail plate, amounted to 2,421,398 long tons, against 2,599,665 tons in 1903, a decrease of 178,267 tons, or over 6.8 per cent. Of the total production in 1904 about 2,353,685 tons were rolled from steel and about 67,713 tons from iron. Skelp iron and steel are not included in the statistics of plates and sheets, but are classed with hoops, bars, etc., elsewhere. The following table gives the production, by States, of all kinds of iron and steel plates and sheets in 1902, 1903, and 1904.

Production of iron and steel plates and sheets in the United States, 1902–1904, by States.

[Long tons.]

State.	1902.	1903.	1904.
New England, New York, and New Jersey	9,240	12,560	14,599
Pennsylvania	1,808,207	1,771,745	1,555,941
Delaware and Maryland	34,282	23,703	23,956
West Virginia	67,072	56,361	108,964
Kentucky and Alabama	56,823	40,635	44,845
Ohio	404,902	403,705	490,192
Indiana, Illinois, Michigan, Missouri, Wisconsin, Colorado, and California	284,883	290,956	182,901
Total	2,665,409	2,599,665	2,421,398

Fourteen States rolled plates and sheets in 1904, against 15 States in 1903. Of the total production of plates and sheets in 1904 Pennsylvania made over 64.2 per cent, against over 68 per cent in 1903; Ohio over 20.2 per cent, against over 15.5 per cent in 1903; West Virginia over 4.5 per cent, against over 2.1 per cent in 1903; and Illinois over 3.7 per cent, against over 5.7 per cent in 1903. Indiana, Kentucky, Maryland, Delaware, Missouri, Massachusetts, Alabama, New Jersey, New York, and California also made plates and sheets in 1904 in the order named. Connecticut, which rolled plates and sheets in 1903, was not a producer in 1904. Michigan and Wisconsin, which made plates and sheets in 1902, were not producers in 1903 or 1904.

The production of iron and steel nail plate in 1904 was 61,601 tons, of which about 42,182 tons were steel and about 19,419 tons were iron. These figures are not included in the foregoing table.

PRODUCTION OF BLACK PLATES, OR SHEETS, FOR TINNING.

The production of black plates, or sheets, for tinning in 1904, which is included in the preceding table, amounted to 472,569 long tons, against 490,652 tons in 1903, a decrease of 18,083 tons, or over 3.6 per cent. Of the production in 1904 Pennsylvania made over 53.4 per cent, against over 52 per cent in 1903. Ohio, Indiana, West Virginia, Illinois, Maryland, and Missouri also made black plates for tinning in 1903 and 1904 in the order named. Almost all the black plates made in 1904 were rolled from steel; only a few thousand tons were rolled from iron.

PRODUCTION OF TIN PLATES AND TERNE PLATES.

The American Iron and Steel Association estimates the production of tin plates and terne plates in the United States in 1904 as amounting to 458,000 long tons, as compared with an estimated production of 480,000 tons in 1903, a decrease of 22,000 tons, or over 4.5 per cent.

PRODUCTION OF MISCELLANEOUS ROLLED PRODUCTS.

In the following table is given the production by States in 1903 and 1904 of merchant bars, skelp, spike rods, bolt rods, splice bars, hoops, bands, cotton ties, strips, rolled axles, rolled armor plate, and other forms of finished rolled iron and steel for which statistics have not been given in preceding pages.

Production of miscellaneous rolled products in 1903 and 1904.

[Long tons.]

State.	1903.	1904.	State.	1903.	1904.
Maine and Massachusetts	30,432	31,858	Ohio	617,221	572,604
Rhode Island and Connecticut	67,546	71,498	Indiana	207,386	183,155
New York	166,693	147,561	Illinois	364,633	289,904
New Jersey	75,981	56,714	Michigan	77,593	47,326
Pennsylvania	2,700,359	2,634,712	Wisconsin	134,649	127,536
Delaware and Maryland	33,330	19,365	Missouri	62,870	50,370
Virginia	41,043	30,502	Colorado and Wyoming	44,583	29,195
West Virginia	189,098	174,572	Washington, Oregon, and California	33,518	30,908
Kentucky	30,233	26,331	Total	4,952,185	4,597,497
Tennessee and Georgia	22,939	28,923			
Alabama	52,078	44,463			

Of the total production of the above products in 1904 about 2,934,601 tons were steel and about 1,662,896 tons were iron.

PRODUCTION OF ALL ROLLED IRON AND STEEL.

The phrase "rolled iron and steel" includes 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 bars, sheet bars, etc.

The production of all kinds of iron and steel in finished forms in the United States in 1904 amounted to 12,013,381 long tons, against 13,207,697 tons in 1903, a decrease of 1,194,316 tons, or over 9 per cent. Of the total production in 1904 about 10,253,297 tons were rolled from steel and about 1,760,084 tons from iron. Twenty-seven States rolled either iron or steel or both iron and steel in 1904, against 25 States in 1903. The following table gives the total production by States of all kinds of finished rolled iron and steel in 1903 and 1904:

Production of all kinds of finished rolled iron and steel in 1903 and 1904, by States.

[Long tons.]

State.	1903.	1904.	State.	1903.	1904.
Maine and Massachusetts	157,627	158,085	Alabama	112,245	195,049
Rhode Island and Connecticut	131,182	108,575	Ohio	1,883,643	1,517,054
New York	255,905	486,870	Indiana	405,076	409,739
New Jersey	145,282	140,572	Illinois	1,481,562	1,241,166
Pennsylvania	7,171,982	6,461,681	Michigan	77,593	47,326
Delaware	47,673	28,521	Wisconsin	204,685	184,511
Maryland	372,009	286,553	Missouri	75,470	59,210
Virginia	43,631	30,746	Colorado and Wyoming	169,409	169,649
West Virginia	252,331	295,939	Kansas, Washington, Oregon, and California	38,904	40,369
Kentucky	158,280	120,534	Total	13,207,697	12,013,381
Tennessee and Georgia	23,208	31,232			

Pennsylvania made over 53.7 per cent of the total production of rolled iron and steel in 1904, against over 54 per cent in 1903; Ohio over 12.6 per cent in 1904, against over 14 per cent in 1903; Illinois over 10.3 per cent in 1904, against over 11 per cent in 1903; New York over 4 per cent in 1904, against over 1.9 per cent in 1903; and Indiana over 3.4 per cent in 1904, against over 3 per cent in 1903. No other State made over 2.5 per cent in 1904 or over 2.9 per cent in 1903. Minnesota did not roll either iron or steel in 1903 or 1904, but it made a small quantity of direct steel castings in both years.

TOTAL PRODUCTION OF FINISHED ROLLED IRON AND STEEL, 1887-1904.

The total production of iron and steel rolled into finished forms in the United States from 1887 to 1904 is as follows. Prior to 1892 structural shapes were included with bars, hoops, etc.:

Production of all kinds of finished rolled iron and steel, 1887–1904.

[Long tons.]

Year.	Iron and steel rails.	Plates and sheets, except nail plate.	Wire rods.	Structural shapes.	Nail plate.	Bars, hoops, 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	453,957	201,242	2,579,482	6,165,814
1893	1,136,458	674,345	537,272	387,307	136,113	2,104,190	4,975,685
1894	1,021,772	682,900	673,402	360,305	108,262	1,795,570	4,642,211
1895	1,306,135	991,459	791,130	517,920	95,085	2,487,845	6,189,574
1896	1,122,010	965,776	623,986	495,571	72,137	2,236,361	5,515,841
1897	1,647,892	1,207,286	970,736	583,790	94,054	2,497,970	7,001,728
1898	1,981,241	1,448,301	1,071,683	702,197	70,188	3,239,760	8,513,370
1899	2,272,700	1,903,505	1,036,398	850,376	85,015	4,146,425	10,294,419
1900	2,385,682	1,794,528	846,291	815,161	70,245	3,575,536	9,487,443
1901	2,874,639	2,254,425	1,365,934	1,013,150	68,850	4,772,329	12,349,327
1902	2,947,933	2,665,409	1,574,293	1,300,326	72,936	5,383,219	13,944,116
1903	2,992,477	2,599,665	1,503,455	1,095,813	64,102	4,952,185	13,207,697
1904	2,284,711	2,421,398	1,699,028	949,146	61,601	4,597,497	12,013,381

COMPARATIVE PRODUCTION OF FINISHED ROLLED IRON AND STEEL.

In 1890 the production of finished rolled steel amounted to 3,504,681 long tons, as compared with 2,518,194 tons of finished rolled iron; in 1889 to 2,927,656 tons of steel, as compared with 2,309,272 tons of iron; and in 1888 to 2,464,086 tons of steel, as compared with 2,153,263 tons of iron. Prior to 1888 complete statistics of the production of rolled steel were not collected by the American Iron and Steel Association.

From 1890 to 1904 the increase in the production of finished rolled steel amounted to 6,748,616 tons, or over 192 per cent, while the decrease in the production of finished rolled iron amounted to 758,110 tons, or over 30 per cent.

The following table gives approximately by States the total production of finished rolled steel in 1904 as compared with the total production of finished rolled iron in the same year. Similar comparative statistics from 1891 to 1903, inclusive, are not available.

Comparative production of finished rolled iron and steel in 1904, by States.

[Long tons.]

State.	Iron.	Steel.	Total.
Maine and Massachusetts	13,690	144,395	158,085
Rhode Island and Connecticut	23,889	84,686	108,575
New York	89,376	397,494	486,870
New Jersey	27,047	113,525	140,572
Pennsylvania	855,453	5,606,228	6,461,681
Delaware	15,903	12,618	28,521
Maryland	2,800	283,753	286,553
Virginia	27,726	3,020	30,746
West Virginia	9,536	286,403	295,939
Kentucky, Tennessee, and Georgia	65,163	86,603	151,766
Alabama	38,058	156,991	195,049
Ohio	198,734	1,318,320	1,517,054
Indiana	184,155	225,584	409,739
Illinois	98,192	1,142,974	1,241,166
Michigan and Wisconsin	17,549	214,288	231,837
Kansas and Missouri	48,374	15,735	64,109
Colorado and Wyoming	10,018	159,631	169,649
Washington, Oregon, and California	34,421	1,049	35,470
Total	1,760,084	10,253,297	12,013,381

In the following table the approximate production of leading articles of finished rolled steel in 1904 is given as compared with the approximate production in the same year of like articles of finished rolled iron. All miscellaneous products are included:

Comparative production of leading articles of finished rolled iron and steel in 1904.

[Long tons.]

Article.	Iron.	Steel.	Total.
Rails	871	2,283,840	2,284,711
Structural shapes	8,019	941,127	949,146
Plates and sheets	67,713	2,353,685	2,421,398
Nail plate	19,419	42,182	61,601
Wire rods	1,166	1,697,862	1,699,028
Merchant bars, skelp, spike rods, splice bars, and other finished rolled products	1,662,896	2,934,601	4,597,497
Total	1,760,084	10,253,297	12,013,381

PRODUCTION OF IRON BLOOMS AND BILLETS.

In 1902, 1903, and 1904 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 and 3,142 tons in 1899. 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, 1903, and 1904. All the Catalan forges in the South have been virtually abandoned; none are now active.

The iron blooms produced in forges from pig iron and scrap in 1904, and which were for sale and not for the consumption of the makers, amounted to 5,743 tons, against 9,940 tons in 1903, 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, and 6,494 tons in 1896, all made in New York, Pennsylvania, and Maryland.

PRODUCTION OF IRON AND STEEL IN ALLEGHENY COUNTY, PA.

The following table gives the number of blast furnaces and completed rolling mills and steel works and the production of pig iron and crude steel, rails, structural shapes, plates and sheets, miscellaneous rolled products, and all finished rolled iron and steel in Allegheny County, Pa., from 1901 to 1904:

Production of pig iron, crude steel, rails, etc., in Allegheny County, Pa., 1901–1904.

[Long tons.]

	1901.	1902.	1903.	1904.
Furnaces built and building ....number..	37	40	41	42
Production of pig iron..................................	3,690,011	4,260,769	4,211,569	4,383,169
Rolling mills and steel works ....number..	63	66	65	64
Production of Bessemer steel........................	2,883,595	3,094,175	2,748,833	2,487,412
Production of open-hearth steel	2,199,191	2,503,245	2,604,349	2,737,560
Production of all other steel.........................	56,053	62,888	51,195	36,408
Total production of steel..............................	5,138,839	5,660,308	5,404,377	5,261,380
Production of all kinds of rails......................	711,031	712,286	749,953	586,210
Production of structural shapes	617,308	773,144	689,849	601,025
Production of plates and sheets	850,285	1,010,650	945,327	839,015
Production of other rolled products................	1,816,587	1,977,179	1,797,795	1,707,545
Production of all rolled products....................	3,995,211	4,473,259	4,182,924	3,733,795

STEEL VESSELS BUILT IN THE CALENDAR YEAR 1904.

The following table, furnished by the Hon. Eugene T. Chamberlain, Commissioner of Navigation, shows the number and gross tonnage of the steel vessels launched in the United States and officially numbered during the calendar year 1904. Vessels for the United States Navy are not included:

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

Ports.	Sailing.		Steam.		Barges.		Total.	
	No.	Gross tonnage.	No.	Gross tonnage.	No.	Gross tonnage.	No.	Gross tonnage.
Boston, Mass			5	4,070	6	5,724	11	9,794
New London, Conn			1	20,718	4	4,000	5	24,718
New York, N. Y	4	8,996	[a]13	3,483			17	12,479
Newark, N. J			1	1,225			1	1,225
Perth Amboy, N. J			1	45	1	303	2	348
Philadelphia, Pa			19	33,267	2	1,908	21	35,175
Wilmington, Del			5	8,263	3	1,103	8	9,366
Baltimore, Md			4	1,801	2	1,052	6	2,853
Richmond, Va			3	4,634			3	4,634
Newport News, Va			1	1,462			1	1,462
Jacksonville, Fla			1	281			1	281
New Orleans, La			2	60			2	60
Pittsburg, Pa					1	479	1	479
Buffalo, N. Y			3	425	3	787	6	1,212
Cleveland, Ohio			6	31,277	1	894	7	32,171
Toledo, Ohio			5	2,258			5	2,258
Detroit, Mich			4	12,040	1	384	5	12,424
Grand Haven, Mich					1	420	1	420
Milwaukee, Wis					1	715	1	715
Chicago, Ill			4	7,538			4	7,538
San Francisco, Cal			2	1,113			2	1,113
Port Townsend, Wash			1	84			1	84
Total	4	8,996	81	134,044	26	17,769	111	160,809

[a] Including 1 vessel of 96 tons built of bronze.

During the calendar year 1903 there were 6 steel sailing vessels launched and numbered, with a gross tonnage of 11,766 tons; 119 steam steel vessels, with 279,781 tons; and 6 steel barges, with 4,293 tons; total number of vessels, 131, with 295,840 tons. There were no iron vessels launched in 1903 or 1904.

SUMMARY OF IRON, STEEL, ETC., STATISTICS FOR 1903 AND 1904.

Summary of iron, steel, etc., statistics for the United States for 1903 and 1904.

[Long tons, except as stated.]

Item.	1903.	1904.
Production of iron ore	35,019,308	27,644,330
Imports of iron ore	980,440	487,613
Production of bituminous coal	252,454,775	249,102,765
Production of Pennsylvania anthracite	66,613,454	65,318,490
Production of all kinds of coal	319,068,229	314,421,255
Shipments of Pennsylvania anthracite	59,362,831	57,492,522
Imports of coal for consumption	3,479,430	1,623,280
Domestic exports of coal	8,312,098	8,573,518
Production of coke ... short tons..	25,262,360	23,621,520
Production of pig iron	18,009,252	16,497,033
Production of spiegeleisen, ferromanganese, and ferrophosphorus, included in pig iron	192,661	220,392
Production of Bessemer steel	8,592,829	7,859,140
Production of open-hearth steel	5,829,911	5,908,166
Production of crucible steel	102,434	83,391
Production of blister and patented steel	9,804	9,190
Production of all kinds of steel	14,534,978	13,859,887
Production of open-hearth steel castings	400,348	302,834
Production of all kinds of steel castings	430,265	330,211
Production of Bessemer steel rails	2,946,756	2,137,957
Production of open-hearth steel rails	45,054	145,883
Production of iron rails	667	871
Production of all kinds of rails	2,992,477	2,284,711
Production of structural shapes	1,095,813	949,146
Production of iron and steel wire rods	1,503,455	1,699,028
Production of plate and sheet iron and steel, except nail plate	2,599,665	2,421,398
Production of bar, bolt, hoop, skelp, rolled axles, rolled armor plate, etc.	4,952,185	4,597,497
Production of all rolled iron and steel, including nail plate and excluding rails	10,215,220	9,728,670
Production of all rolled iron and steel, including both nail plate and rails.	13,207,697	12,013,381
Production of iron and steel cut nails and cut spikes..kegs of 100 pounds..	1,435,893	1,283,362
Production of iron and steel wire nails ... do....	9,631,661	11,926,661
Production of tin plates and terneplates	480,000	458,000
Production of ore, pig, and scrap blooms for sale	9,940	5,743
Imports of iron and steel ... foreign value..	$41,255,864	$21,621,970
Exports of iron and steel ... home value..	$99,035,865	$128,553,613
New railroad built (estimated for 1904) ... miles..	4,715	4,252
Tonnage of steel vessels built in the calendar year	295,840	160,809
Immigrants in the year ended December 31	937,371	808,967

STATISTICS OF THE CANADIAN IRON TRADE FOR 1904.

PRODUCTION OF PIG IRON IN CANADA.

The American Iron and Steel Association has received from the manufacturers the statistics of the production of pig iron in the Dominion of Canada in the calendar year 1904. They show an increase of 5,524 long tons, or a little over 2 per cent, as compared with 1903.

The total production of all kinds of pig iron in Canada in 1904 amounted to 270,942 long tons, against 265,418 tons in 1903, 319,557 tons in 1902, 244,976 tons in 1901, and 86,090 tons in 1900. In the first half of 1904 the production was 120,643 tons, and in the second half it was 150,299 tons, an increase of 29,656 tons. In 1904 of the total production 251,671 tons were made with coke and 19,271 tons with charcoal. About one-fourth of the total production was basic pig iron and a little less than one-tenth was Bessemer pig iron. Spiegeleisen and ferromanganese have not been made in Canada since 1899.

The following table gives the total production of all kinds of pig iron (including spiegeleisen and ferromanganese) in Canada from 1894 to 1904. 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, 1894–1904.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1894	44,791	1898	68,755	1902	319,557
1895	37,829	1899	94,077	1903	265,418
1896	60,030	1900	86,090	1904	270,942
1897	53,796	1901	244,976		

On December 31, 1904, the unsold stocks of pig iron in Canada amounted to 35,119 tons, as compared with 19,168 tons at the close of 1903, 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, 1904, Canada had 15 completed blast furnaces, of which 8 were in blast and 7 were idle. Of this total, 10 were equipped to use coke for fuel and 5 to use charcoal. In addition, 3 coke furnaces, upon which work had been suspended for some time, were partly erected on December 31.

During the first half of 1904 Canada had 10 of its completed furnaces in blast, and during the last half of the year it had the same number of furnaces running. Of the active furnaces in each half year, 7 were coke and 3 were charcoal furnaces.

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 finished rolled iron and steel in Canada in 1904.

The total production of steel ingots and castings in Canada in 1904 was 148,784 long tons, against 181,514 tons in 1903, a decrease of 32,730 tons. Bessemer and open-hearth steel ingots and castings were made in each year. Almost all the open-hearth steel reported in 1903 and 1904 was made by the basic process. The direct steel castings made in 1904 amounted to 6,505 tons. Canada has not made crucible steel prior to the present year.

The following table gives the production of all kinds of steel ingots and castings in Canada from 1894 to 1904:

Production of all kinds of steel ingots and castings in Canada, 1894–1904.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1894	25,685	1898	21,540	1902	182,037
1895	17,000	1899	22,000	1903	181,514
1896	16,000	1900	23,577	1904	148,784
1897	18,400	1901	26,084		

PRODUCTION OF FINISHED ROLLED IRON AND STEEL IN CANADA.

The following table gives the production of all kinds of iron and steel rolled into finished forms in Canada from 1895 to 1904:

Production of all kinds of finished rolled iron and steel in Canada, 1895–1904.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1895	66,402	1899	110,642	1903	129,516
1896	75,043	1900	100,690	1904	180,038
1897	77,021	1901	112,007		
1898	90,303	1902	161,485		

The production of Bessemer and open-hearth steel rails in 1904 amounted to 36,216 long tons, against 1,243 tons in 1903; structural shapes, 447 tons, against 1,983 tons in 1903; cut nails made by rolling mills and steel works having cut-nail factories connected with their plants, 99,000 kegs of 100 pounds, against 118,686 kegs in 1903; plates and sheets, 3,102 tons, against 2,450 tons in 1903; all other finished rolled products, excluding muck and scrap bars, blooms, billets, sheet bars, and other unfinished forms, 135,243 tons, against 118,541 tons in 1903. The total quantity of all kinds of iron and steel rolled into finished forms in Canada in 1904 amounted to 180,038 tons, against

129,516 tons in 1903. Of the 180,038 tons of finished iron and steel reported for 1904 about 126,850 tons were rolled from steel and 53,188 tons from iron.

On December 31, 1904, there were 18 completed rolling mills and steel works in Canada. In addition 3 plants were being built and 2 plants were projected. 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. Of the building plants 1 was being equipped for the manufacture of steel castings by a special process, 1 for the manufacture of open-hearth steel ingots only, and 1 for the manufacture of merchant bar iron, railway spikes, etc. One of the projected plants is to be equipped for the manufacture of skelp and bar iron and the other for the manufacture of wire rods.

Of the 18 completed rolling mills and steel works in Canada on December 31, 1904, 3 were located in Nova Scotia, 5 in Quebec, 9 in Ontario, and 1 in New Brunswick. The building plants are in Nova Scotia, Ontario, and Manitoba, and the projected plants are in Ontario.

PRODUCTION OF IRON ORE AND COAL IN CANADA.

It is officially stated that the production of iron ore in Canada in 1904 amounted to 312,286 long tons, against 235,977 tons in 1903, and that the production of coal in Canada in 1904 amounted to 6,705,232 long tons, against 6,824,999 tons in 1903. The figures for 1904 are subject to revision.

STATISTICS OF THE EUROPEAN IRON TRADE FOR 1904.

GREAT BRITAIN.

Mr. Jeans, the secretary of the British Iron Trade Association, has published the statistics of the production of pig iron, Bessemer steel, and open-hearth steel in Great Britain in 1904, from which the following summary is compiled:

Pig iron.—The total production of pig iron in 1904 amounted to 8,562,658 long tons, against 8,811,204 tons in 1903, 8,517,693 tons in 1902, and 7,851,830 tons in 1901. The decrease in 1904 as compared with 1903 was 248,546 tons. The production of iron ore in 1904 amounted to 13,774,282 tons, as compared with 13,715,645 tons in 1903. Great Britain is a large importer of iron ore for use in its blast furnaces. The imports of iron ore in 1904 amounted to 6,100,556 tons, against 6,314,162 tons in 1903, of which there were imported from Spain 4,648,335 tons in 1904 and 4,945,086 tons in 1903. The official Government statistics for 1904 may vary from those here given. The pig-iron statistics given by Mr. Jeans for previous years also vary from the Government statistics.

Bessemer steel.—The total production of Bessemer steel ingots in 1904 amounted to 1,781,533 long tons, against 1,910,018 tons in 1903, 1,825,-779 tons in 1902, and 1,606,253 tons in 1901. The decrease in 1904 as compared with 1903 was 128,485 tons. Of the total production in 1904 there were produced by the acid process 1,129,224 tons and by the basic process 652,309 tons. Nearly one-half (304,817 tons) of the basic Bessemer production of 1904 was produced in the Cleveland district. In this district the production of acid Bessemer steel has been gradually declining in recent years, until in 1904 it fell to 10,449 tons.

Open-hearth steel.—The total production of open-hearth steel ingots in 1904 amounted to 3,245,346 long tons, against 3,124,083 tons in 1903, 3,083,288 tons in 1902, and 3,290,791 tons in 1901. The increased production in 1904 as compared with 1903 was 121,263 tons. Of the total production last year 662,064 tons were basic steel and 2,583,282 tons were acid steel. Since 1901 the production of basic open-hearth steel in Great Britain has almost doubled. It will be observed, however, that the aggregate production of open-hearth steel in Great Britain has made no progress in the last four years, the output in 1904 being a little less than in 1901.

The production in Great Britain of direct steel castings by the Bessemer and open-hearth processes is never given in British statistics, nor is the production of crucible steel ingots and castings. The American Iron and Steel Association has estimated the annual production of crucible steel in Great Britain in recent years as amounting to 100,000 tons.

Coal.—Complete statistics of the production of coal in Great Britain in 1904 have been published by the mining statistics branch of the Home Department of His Majesty's Government. The production in 1904 was 232,428,272 tons, against 230,334,469 tons in 1903.

GERMANY.

The Imperial Statistical Bureau of Germany publishes the following statistics of the production of coal and lignite and iron ore in the German Empire, including Luxemburg, in 1904, compared with the production in 1903:

Coal and lignite.—The production of coal in Germany in 1904 was 120,815,503 metric tons, against 116,637,765 tons in 1903. The production of lignite in 1904 was 48,632,769 tons, against 45,819,488 tons in 1903. The total production of coal and lignite in 1904 was 169,448,272 tons, against 162,457,253 tons in 1903. The production of coal and lignite in 1904 was 6,991,019 tons greater than in 1903.

Iron ore.—The production of iron ore in Germany in 1904 was 22,047,297 metric tons, against 21,230,650 tons in 1903—an increase in 1904 of 816,647 tons.

Pig iron.—Doctor Leidig, chief of the statistical bureau of the Verein Deutscher Eisen und Stahl Industrieller, gives the production of pig iron in Germany and Luxemburg in 1904 as provisionally amounting to 10,103,941 metric tons, against 10,085,634 tons in 1903—an increase of 18,307 tons.

Steel.—Doctor Leidig also gives the production of Bessemer and open-hearth steel ingots and castings in Germany and Luxemburg as amounting in 1904 to 8,930,291 metric tons, against 8,801,515 tons in 1903. Of the production in 1904, 5,949,171 tons were Bessemer ingots, of which 423,742 tons were made by the acid process and 5,525,429 tons by the basic process, and 2,828,306 tons were open-hearth ingots, of which 130,546 tons were made by the acid process and 2,697,760 tons by the basic process. The total production of direct steel castings in 1904 amounted to 152,814 tons, of which 56,409 tons were made by the acid process and 96,405 tons by the basic process. Doctor Leidig does not separate Bessemer from open-hearth castings.

FRANCE.

The Journal Officiel gives the following provisional statistics of the production of iron and steel in France in 1904, compared with definite statistics for 1903:

Pig iron.—The production of pig iron in France in 1904 amounted to 2,999,787 metric tons, against 2,840,517 tons in 1903, an increase of 159,270 tons.

Steel.—The production of Bessemer and open-hearth steel ingots in France in 1904 was as follows, in metric tons: Bessemer steel, 1,334,798 tons; open-hearth steel, 745,756 tons; total, 2,080,554 tons, against 1,161,954 tons of Bessemer steel and 677,674 tons of open-hearth steel in 1903, making a total of 1,839,628 tons in that year. The production of steel by various minor processes in 1904 amounted to 26,785 metric tons, against 23,058 tons in 1903. The total production of steel in the above forms in 1904 was 2,107,339 tons, against a total production in 1903 of 1,862,686 tons. In the foregoing statistics steel castings are not included. In 1903 they amounted to about 23,000 tons.

BELGIUM.

Pig iron.—The production of pig iron in Belgium in 1904 is reported to have amounted to 1,307,399 metric tons, against 1,216,500 tons in 1903, an increase of 90,899 tons.

Steel.—The production of Bessemer and open-hearth steel ingots in Belgium in 1904 is reported to have amounted to 1,083,000 metric tons, against 969,230 tons in 1903, an increase of 113,770 tons.

THE WORLD'S IRON TRADE IN 1903.

THE WORLD'S PRODUCTION OF IRON ORE.

In the following table are given revised statistics of the production of iron ore in all countries in 1903, except in a few instances, when figures for 1902 and 1901 are given. English tons of 2,240 pounds are used in giving the production of the United States, Great Britain, Canada, Cuba, India, Natal, Transvaal, New South Wales, New Zealand, other Australasia, and "other countries," and metric tons of 2,204 pounds are used for all other countries named in the table, the latter being used as the equivalent of English tons in ascertaining the total production of all countries:

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

Country.	Iron ore.		
	Year.	Quantity.	Percentage.
		Tons.	
United States	1903	35,019,308	34.41
Great Britain	1903	13,715,645	13.48
Germany and Luxemburg	1903	21,230,650	20.86
France	1903	6,219,541	6.11
Belgium	1903	184,400	.18
Austria-Hungary[a]	1903	3,269,175	3.21
Russia and Finland	1902	5,648,227	5.55
Sweden	1903	3,677,841	3.61
Spain	1903	8,304,153	8.16
Italy	1903	374,790	.37
Dominion of Canada	1903	235,977	.23
Cuba	1903	624,858	.61
India	1902	85,235	.08
Greece	1903	360,310	.35
New South Wales	1902	13,555	.01
Other Australasia	1902	116,994	.12
Japan	1901	70,172	.07
Algeria	1903	588,893	.58
Other countries (about)	1903	2,045,276	2.01
Total		101,785,000	100.00

[a] Includes Bosnia and Herzegovina.

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 are given revised statistics of the production of pig iron and steel in all countries in 1903. English 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 English 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, Italy, and Canada embrace ingots and in some cases direct castings.

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	38.84	1903	14,534,978	40.55
Great Britain	1903	8,935,063	19.27	1903	[a] 5,134,101	14.32
Germany and Luxemburg	1903	10,085,634	21.75	1903	8,801,515	24.55
France	1903	2,840,517	6.13	1903	1,885,000	5.26
Belgium	1903	1,216,500	2.63	1903	969,230	2.70
Austria-Hungary [b]	1903	1,428,158	3.08	1902	[c] 1,193,000	3.33
Russia and Finland	1903	2,453,953	5.29	1903	2,374,650	6.63
Sweden	1903	506,825	1.09	1903	318,897	.89
Spain	1903	302,657	.65	1903	199,642	.56
Italy	1903	[d] 75,279	.16	1903	187,361	.52
Dominion of Canada	1903	265,418	.57	1903	181,514	.51
Other countries (about)	1903	248,744	.54	1903	66,112	.18
Total	....	46,368,000	100.00	....	35,846,000	100.00

[a] Does not include direct steel castings.
[b] Includes Bosnia and Herzegovina.
[c] Estimated. Official figures wanting.
[d] Not including blast-furnace castings.

In tables that have appeared in previous issues of this report 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 46,368,000 tons for 1903, the United States contributing nearly 39 per cent.

The world's production of steel was estimated as amounting to 3,021,000 long tons in 1878. The production of 1889 was estimated as amounting to 10,948,000 tons. The figures given in the preceding table show that the world's production of steel had increased in 1903 to 35,846,000 tons, of which the United States contributed over 40 per cent.

PRODUCTION OF MANGANESE ORES IN 1904.

By John Birkinbine.

PRODUCTION.

The production of manganese ores in the United States in the year ending December 31, 1904, was 3,146 long tons, valued at $29,466, or $9.37 per ton. This is 321 long tons, or 11 per cent, more than the quantity reported in 1903, viz, 2,825 long tons.

The following table gives the production of various States and the value per ton of the manganese ores mined in the United States in the years 1896–1904, inclusive:

Production and value of manganese ores in the United States, 1896–1904.

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
North Carolina				37	370	10.00			
Pennsylvania	2	17	8.50						
Tennessee	265	1,988	7.50	354	2,832	8.00			
Utah				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, 1896–1904—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	$1,530	$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.			1904.		
	Quantity.	Value.	Average value per ton.	Quantity.	Value.	Average value per ton.	Quantity.	Value.	Average value per ton.
	Long tons.			*Long tons.*			*Long tons.*		
Arkansas	82	$422	$5.15						
California	846	10,175	12.03	16	$116	$7.25	60	$900	$15.00
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	32	160	5.00
Virginia	3,041	29,444	9.68	1,801	19,611	10.89	3,054	28,406	9.30
Total	7,477	60,911	8.15	2,825	25,335	8.97	3,146	29,466	9.37

In 1904 only three States—California, Utah, and Virginia—supplied manganese ore, but manganiferous iron ore was obtained in Colorado, Arkansas, and in the Lake Superior region. Georgia and Arkansas, which in former years were important contributors, reported the mines idle.

Of the 1904 total 3,054 tons, or 97 per cent, came from Virginia, 60 tons, or 2 per cent, from California, and 32 tons, or 1 per cent, from Utah.

The following table presents the production of manganese ores in Virginia, Georgia, Arkansas, and other States, the total production and the total value for the years 1880 to 1904, inclusive, as also totals for the quarter century covered between the dates named:

Production of manganese ores in the United States, 1880–1904.

[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
1904	3,054	None.	....	92	3,146	29,466
Total for 25 years	195,922	72,144	49,404	26,011	343,481	3,274,397

PRODUCTION OF MANGANIFEROUS IRON ORES.

In addition to the true manganese ores considerable quantities of manganiferous iron ore are obtained, which, although included in the statistics of iron ore report for 1904, are also noted here.

In Arkansas 600 tons of this class of ore, carrying 28 per cent of manganese and 10 to 14 per cent of iron, were mined and used in the manufacture of pig iron, with 1 per cent or over of manganese.

The Colorado manganiferous iron ores, many of which contain varying amounts of silver, are primarily utilized as flux by the precious metal smelters, the remainder being used in the manufacture of spiegeleisen.

In the Lake Superior region quantities of iron ore are mined which analyze from a fraction of 1 per cent up to 20 per cent of manganese. Some of these ores from the same exploitation are used as iron ores and some in the production of spiegeleisen; hence it is impossible to segregate closely the quantities so used.

The quantities of manganiferous iron ore mined by States in 1903 and 1904, together with total and average value per ton, are given in the next table.

Production, percentage of manganese, and total and average value of manganiferous iron ores, 1901–1904.

Locality.	1901.				1902.			
	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	62,385	16 to 30	$248,084	$3.98	13,275	18 to 32	$52,371	$3.95
Lake Superior region	512,084	1 to 10	1,226,952	2.40	884,939	1 to 10	1,946,255	2.20
North Carolina	20	Not given.	48	2.40	3,000	Not given.	3,000	1.00
Total	574,489	1 to 30	1,475,084	2.57	901,214	1 to 32	2,001,626	2.22

Locality	1903.				1904.			
	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.*			
Arkansas	....	....	....	....	600	28	$1,200	$2.00
Colorado	14,856	Not given.	$55,710	$3.75	17,074	15 to 32	54,104	3.17
Lake Superior region	566,835	1 to 23	1,511,557	2.67	365,572	1 to 10	636,173	1.74
Virginia	2,802	Not given.	4,483	1.60	....	....	....	....
Total	584,493	1 to 23	1,571,750	2.69	383,246	1 to 32	691,477	1.80

The quantities of this kind of ore produced annually from 1889 to 1904, inclusive, together with the total value and the average value per ton, are shown in the next table.

Production of manganiferous iron ores in the United States, 1889–1904.

[Maxima in italics.]

Year.	Quantity.	Value.	Average value per ton.
	Long tons.		
1889	83,434	$271,680	$3.26
1890	61,863	231,655	*3.74*
1891	132,511	314,099	2.37
1892	153,373	354,664	2.31
1893	117,782	283,228	2.40
1894	205,488	408,597	1.99
1895	125,729	233,998	1.86
1896	338,712	726,413	2.14
1897	202,304	343,784	1.70
1898	287,810	429,302	1.49
1899	761,845	1,147,047	1.51
1900	377,577	1,037,314	2.75
1901	574,489	1,475,084	2.57
1902	*901,214*	*2,001,626*	2.22
1903	584,493	1,571,750	2.69
1904	383,246	691,477	1.80

ARGENTIFEROUS MANGANIFEROUS IRON ORES.

In mining silver ores in Colorado mineral is obtained which contains insufficient percentages of the precious metal to make it valuable on that account, but which is used as a flux by the smelters. This ore is considered an iron ore and is included in the report on that mineral, but the quantities mined annually from 1889 to 1904, inclusive, together with the total value and the average value per ton, are given in the table following:

Production of manganiferous silver ores in the United States, 1889–1904.

[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
1904	105,278	348,132	3.31

[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 ORE.

A by-product in the manufacture of zinc from ores mined in northern New Jersey, containing iron and manganese, is utilized in the production of spiegeleisen. In 1904, 68,189 long tons of this class of ore were obtained. The production of this material from 1889 to 1904, inclusive, the total value, and the average value per ton are given in the next table.

Production of manganiferous zinc ore residuum in the United States, 1889–1904.

[Maxima in italics.]

Year.	Quantity.	Value.	Average value per ton.
	Long tons.		
1889	43,648	$54,560	$1.25
1890	48,560	*60,700*	1.25
1891	38,228	57,432	*1.50*
1892	31,859	25,937	.81
1893	37,512	30,535	.81
1894	26,981	20,464	.76
1895	43,249	24,451	.57
1896	44,953	20,455	.46
1897	33,924	18,713	.55
1898	48,502	[a] 26,676	.55
1899	65,010	32,505	.50
1900	*87,110*	34,844	.40
1901	52,311	52,311	1.00
1902	65,246	65,246	1.00
1903	73,264	73,264	1.00
1904	68,189	68,189	1.00

[a] Estimated.

COMBINED PRODUCTION OF MANGANESE ORES AND MANGANIFEROUS ORES.

The total quantity of manganese ore, manganiferous iron ore, argentiferous manganiferous ore, and zinc residuum produced in the United States in the years 1901 to 1904, inclusive, and the value of the same, are presented in the following table:

Production of manganese ores and manganiferous ores in the United States in 1901, 1902, 1903, and 1904.

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

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

Production of manganese ores and manganiferous ores in the United States in 1901, 1902, 1903, and 1904—Continued.

Kind of ore.	1903.			1904.		
	Quantity.	Value.	Average value per ton.	Quantity.	Value.	Average value per ton.
	Long tons.			*Long tons.*		
Manganese ores	2,825	$25,335	$8.97	3,146	$29,466	$9.37
Manganiferous iron ores	584,493	1,571,750	2.69	383,246	691,477	1.80
Manganiferous silver ores	179,205	649,727	3.63	105,278	348,132	3.31
Manganiferous zinc residuum[a]	73,264	73,264	1.00	68,189	68,189	1.00
Total	839,787	2,320,076	2.76	559,859	1,137,264	2.03

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

The following data indicate special features of production of manganese and manganiferous ores in various States:

PRODUCTION OF MANGANESE ORES BY STATES.

ARKANSAS.

In the year 1904 no manganese ore was reported as mined in this State, but from one of the dumps 600 tons of ore were recovered, carrying 28 per cent of manganese and 10 to 14 per cent of iron. Arkansas was an important producer in previous years, most of the manganese ore being mined in the Batesville district.

In the following statement will be found the annual production from the initial shipment, about 1850, to the close of 1904:

Production of manganese in the Batesville district of Arkansas from 1850 to 1904, inclusive.

[Maximum in italics.]

Year.	Authority.	Quantity.
		Long tons.
1850 to 1888	Various authorities	16,647
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.
1904	do	None.
Total		49,971

CALIFORNIA.

In this State small quantities of manganese ore are mined, the greater portion going to chlorination works. The quantity produced in the year 1904 was 60 tons, valued at $900, the total output from 1874 to 1904, inclusive, as shown in the table, being 11,434 tons.

Total production of manganese ores in California, 1874–1904.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1874 to 1888	6,000	1898	541
1889	53	1899	115
1890	386	1900	131
1891	705	1901	610
1892	....	1902	846
1893	400	1903	16
1894	278	1904	60
1895	525	Total	11,434
1896	284		
1897	484		

COLORADO.

In mining for precious metals quantities of ore are obtained which carry manganese and iron, but insufficient silver to make them valuable on this latter account. Some of this ore, sufficiently high in manganese, is used in the production of spiegeleisen, the remainder being utilized by smelters for fluxing purposes. In the year 1904 17,074 long tons were supplied for the manufacture of spiegeleisen and 105,278 tons for flux.

The following table gives the quantities of the two classes of manganiferous iron ore mentioned which have been mined in Colorado from 1889 to 1904, inclusive:

Production of manganiferous ores in Colorado, 1889–1904.

[Long tons.]

Year.	Manganiferous iron ores used for producing spiegeleisen.	Manganiferous silver ores.	Total.
1889	2,075	64,987	67,062
1890		51,840	51,840
1891	964	79,511	80,475
1892	3,100	62,309	65,409
1893	5,766	54,462	60,228
1894	7,022	30,187	37,209
1895	13,464	53,506	66,970
1896	9,072	137,597	146,669
1897	16,519	149,502	166,021
1898	18,848	99,651	118,499
1899	29,355	79,855	109,210
1900	43,303	188,509	231,812
1901	62,385	228,187	290,572
1902	13,275	194,132	207,407
1903	14,856	179,205	194,061
1904	17,074	105,278	122,352

UTAH.

In the year 1904 only 32 tons of manganese ore were mined in this State. The deposits of ore are reported to be of good character, but far from points of consumption.

VIRGINIA.

This State has long been the most prominent producer of manganese ore, and for the last twenty-five years it has ranked first with but six exceptions. In 1904, 3,054 long tons of ore were mined, making the total output for the quarter century 195,922 tons.

The next table shows the annual production of manganese ores in Virginia from 1880 to 1904, inclusive.

Production of manganese ores in Virginia, 1880–1904.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1880 to 1888, inclusive	101,066	1898	5,662
1889	14,616	1899	6,228
1890	12,699	1900	7,881
1891	16,248	1901	4,275
1892	6,079	1902	3,041
1893	4,092	1903	1,801
1894	1,797	1904	3,054
1895	1,715	Total	195,922
1896	2,018		
1897	3,650		

NOTE.—Maximum production 20,567 tons, in 1886.

IMPORTS OF MANGANESE ORES.

The greater portion of the manganese finds its principal use in the manufacture of steel. It is imported from foreign countries either in the manufactured forms of spiegeleisen or ferromanganese or as ore to be smelted in the American furnaces. The quantity of ore imported in the year ending December 31, 1904, was 108,519 long tons, valued at $901,592, an average of $8.38 per ton, as against 146,056 tons, valued at $1,278,108, brought in in 1903.

The principal contributor was Brazil, 66,875 tons, followed by Cuba, 16,239 tons; Russia, 11,959 tons, and British East Indies, 10,200 tons. Smaller quantities, which from the high valuations were evidently imported for some other content than manganese, came from Germany, Japan, United Kingdom, Canada, and Belgium.

The next table, prepared from data furnished by the Bureau of Statistics of the Department of Commerce and Labor, gives the quantities and values of the imports by countries in the years 1899 to 1904, inclusive.

Imports of manganese ores into the United States during the calendar years 1899, 1900, 1901, 1902, 1903, and 1904, 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, 1903, and 1904, by countries—Continued.

Country.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Brazil	102,550	$1,006,969	76,910	$738,885	66,875	$589,089
Russia, Black Sea	3,338	24,581	1,596	15,565	11,959	98,002
Russia, Baltic and White seas			3,980	39,800		
British East Indies	64,170	352,487	35,960	226,796	10,200	58,635
Cuba	36,294	285,571	17,721	111,670	16,239	80,974
Chile			3,451	25,555		
Colombia	700	3,385				
Turkey in Europe	12,609	88,979				
Japan	2,481	37,064	409	10,593	996	12,651
Germany	2,155	68,241	2,837	77,985	1,031	33,365
United Kingdom	451	10,814	393	23,138	993	22,533
Quebec, Ontario, etc	140	820	3	303	1	63
NovaScotia, New Brunswick, etc.	59	2,311	35	1,395	117	3,824
Austria-Hungary			1	35		
Spain	10,464	48,098	2,244	5,836		
Belgium	165	1,962	25	552	108	2,456
Total	235,576	1,931,282	146,056	1,278,108	108,519	901,592

The larger part of the manganese ore imported in 1904 was received at the Atlantic ports of Baltimore, Philadelphia, and New York, these ranking in the order named, 88,360 tons, or over 81 per cent, being thus accounted for. Of the remainder, 19,844 tons were entered at Mobile, for use in the steel industries in the Birmingham district, and small quantities were shipped to Chicago, Newport News, Boston, Huron, etc.

The manganese imports by customs districts from 1899 to 1904, inclusive, with the value of the same, will be found in the following table:

Manganese ore imported into the United States during the calendar years 1899, 1900, 1901, 1902, 1903, and 1904, by customs districts.

Customs district.	1904.		1903.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Philadelphia, Pa	33,651	$294,408	933	$25,600	1,007	$30,927
Baltimore, Md	49,876	422,453	115,701	999,835	200,434	1,583,303
New York, N. Y	4,833	65,450	3,893	72,091	4,287	77,978
Perth Amboy, N. J			2,244	5,836		
Pittsburg, Pa			17	1,459	10	850
Newport News, Va	83	2,102	613	18,332	53	1,616
Chicago, Ill	184	6,140	153	6,397	116	4,874
Boston, Mass	3	195	6	408	32	1,450
New Orleans, La			4,750	34,170		
Pensacola, Fla					5,339	46,281
Mobile, Ala	19,844	109,564	17,721	111,670	24,158	183,157
Huron, Mich	1	63	3	303	30	240
Champlain, N. Y					30	240
All others	44	1,217	22	2,007	80	366
Total	108,519	901,592	146,056	1,278,108	235,576	1,931,282

Manganese ore imported into the United States during the calendar years 1899, 1900, 1901, 1902, 1903, and 1904, by customs districts—Continued.

Customs district.	1901.		1900.		1899.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Philadelphia, Pa	24,396	$188,869	80,333	$726,545	90,583	$655,061
Baltimore, Md	120,579	1,004,750	161,932	1,134,823	80,006	739,547
New York, N. Y	8,103	110,979	13,883	176,944	14,762	152,959
Norfolk, Va					2,901	32,248
Pittsburg, Pa	40	2,994	25	1,578	44	2,473
Newport News, Va	26	862	15	568	26	1,351
Chicago, Ill	48	2,392			16	595
Boston, Mass	25	691	1	24	5	116
Pensacola, Fla	8,935	127,159				
Mobile, Ala	3,100	44,100				
Huron, Mich	396	3,170				
Passamaquoddy, Me			2	30	4	82
Champlain, N. Y	72	499				
All others	2	108	61	1,849	2	96
Total	165,722	1,486,573	256,252	2,042,361	188,349	1,584,528

That the United States is dependent upon foreign sources for the major portion of its manganese ores is evident from the next table, which shows the relative quantities and values of manganese ore produced in this country and imported for the years 1889 to 1904, inclusive.

For sixteen years the average annual production of domestic manganese ore was 12,174 long tons, valued at $109,423, while for the same time the average quantity imported was 105,720 long tons, valued at $950,508. In this interval practically 90 per cent of the supply of manganese ore came from foreign countries.

Relative quantities and values of domestic and imported manganese ores, 1889–1904.

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
1904	3,146	29,466	108,519	901,592
Total for 16 years	194,785	1,750,760	1,691,525	15,208,132
Average for 16 years	12,174	109,423	105,729	950,508

PRODUCTION OF DOMESTIC AND IMPORTS OF FOREIGN SPIEGELEISEN AND FERROMANGANESE.

In the manufacture of steel, manganese is used in the form of ferromanganese or spiegeleisen, and most of the foreign ores brought into this country are utilized in this way. In the calendar year 1904, according to data collected by the American Iron and Steel Association, there were produced in the United States 57,076 tons of ferromanganese and 162,370 tons of spiegeleisen, and there were imported 21,813 tons of ferromanganese and 4,623 tons of spiegeleisen, a total of 245,882 tons.

The next table gives the total domestic production of these metals for the years 1893 to 1904, inclusive.

Production of domestic spiegeleisen and ferromanganese, calendar years 1893–1904.

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	1904	219,446

When the prices of foreign "ferro" and "spiegel" are low the importations are augmented, for it may be more advantageous to purchase foreign metal than to import ores of manganese and smelt them.

In the fiscal year ending June 30, 1904, there were imported into the United States 23,903 tons of ferromanganese and 50,620 tons of spiegeleisen, the combined value being $2,080,645. The following table, prepared from data furnished by the Bureau of Statistics of the Department of Commerce and Labor, gives the imports of ferromanganese and spiegeleisen for the fiscal years 1898 to 1904, inclusive, and of both metals combined from 1884 to 1897, inclusive; also the total value. The marked variation in quantity and value from year to year will be noted.

Imports of ferromanganese and spiegeleisen for fiscal years ending June 30, 1884–1904.

Year.	Ferromanganese.	Spiegeleisen.	Total.	
			Quantity.	Value.
	Long tons.	*Long tons.*	*Long tons.*	
1884			94,210	$2,353,368
1885			65,406	1,587,103
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	280,840
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
1904	23,903	50,620	74,523	2,080,645

Commercial ferromanganese may be considered as containing 80 per cent of manganese, and spiegeleisen as carrying 20 per cent of manganese.

PRODUCTION OF MANGANESE IN FOREIGN COUNTRIES.

As most of the manganese ore used in the United States comes from various foreign countries it may be of interest to refer briefly to some of these sources.

CANADA.

Manganese has been mined in small quantities in the Provinces of Nova Scotia and New Brunswick, and a preliminary report made by Mr. Elfric Drew Ingall, M. E., of the Geological Survey of Canada, gives the export of manganese ore in 1904 as 123 short tons, valued at $2,706.

The following table gives the export of manganese ore from Canada from 1873 to 1904, inclusive, with the value of the same, thus practically covering the production of this ore, as only a small quantity has been smelted in the Dominion:

Exports of manganese ore from Canada, 1873–1904.

Year.	Nova Scotia.		New Brunswick.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1873	....	....	1,031	$20,192	1,031	$20,192
1874	6	$12	776	16,961	782	16,973
1875	9	200	194	5,314	203	5,514
1876	21	723	391	7,316	412	8,039
1877	106	3,699	785	12,210	891	15,909
1878	106	4,889	520	5,971	626	10,860
1879	154	7,420	1,732	20,016	1,886	27,436
1880	79	3,090	2,100	31,707	2,179	34,797
1881	200	18,022	1,504	22,532	1,704	40,554
1882	123	11,520	771	14,227	894	25,747
1883	313	8,635	1,013	16,708	1,326	25,343
1884	134	11,054	469	9,035	603	20,089
1885	77	5,054	1,607	29,595	1,684	34,649
1886	[a] 441	30,854	1,377	27,484	[a] 1,818	58,338
1887	578	14,240	837	20,562	1,415	34,802
1888	87	5,759	1,094	16,073	1,181	21,832
1889	59	3,024	1,377	26,326	1,436	29,350
1890	177	2,583	1,729	34,248	1,906	36,831
1891	22	563	233	6,131	255	6,694
1892	84	6,180	59	2,025	143	8,205
1893	123	12,409	10	112	133	12,521
1894	11	720	45	2,400	56	3,120
1895	108	6,348	$\frac{3}{10}$	3	$108\frac{3}{10}$	6,351
1896	124	3,975	....	....	124	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
1904	....	....	....	....	123	2,706

[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.

The active manganese mines of Cuba are located in the Province of Santiago de Cuba, in the southeastern portion of the island. In the year 1904 only those owned by the Ponupo Mining and Transportation Company were operated, the shipments in that year being 15,516 long tons.

The following table gives the annual exports of manganese ore from the Santiago district of Cuba for the years 1888 to 1904, inclusive:

Exports of manganese ore from Santiago district, Cuba, 1888–1904.

Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*
1888	1,942	1897	None.
1889	704	1898	950
1890	21,810	1899	13,686
1891	21,987	1900	22,600
1892	18,751	1901	25,183
1893	10,640	1902	39,628
1894	....	1903	18,795
1895	1,394	1904	15,516
1896	None.		

BRAZIL.

In the year 1904 over one-half of the foreign manganese ore imported into the United States came from Brazil, the principal supply being obtained from the Minas Geraes district, a small quantity coming from the Nazareth district. The manganese deposits in these districts were described in the 1902 report.

No data in regard to the year 1904 are at hand, but the following table gives the exports of manganese ore for the years 1896 to 1903, inclusive:

Exports of Brazilian manganese ore, 1896–1903.

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	1903	159,369

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

CHILE.

Numerous deposits of manganese ore are reported in Chile. Those which are exploited are in the Provinces of Atacama and Santiago, the ore mined being exported.

The next table gives the exports of Chilean manganese ores for the years 1885 to 1902, inclusive, and 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.

In 1903 there were mined in Great Britain 818 long tons of manganiferous iron ore. The next table gives the quantity and value of manganiferous iron ore produced in Great Britain from 1884 to 1903.

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	$3,582
1885	1,688	11,669	1895	1,273	3,323
1886	12,763	52,722	1896	1,080	2,983
1887	13,777	53,772	1897	599	[a] 1,650
1888	4,342	9,361	1898	231	974
1889	8,852	31,354	1899	415	1,212
1890	12,444	32,588	1900	1,362	3,285
1891	9,476	30,071	1901	1,646	....
1892	6,078	21,461	1902	1,278	3,319
1893	1,336	3,688	1903	818	3,191

[a] Estimated.

BELGIUM.

The quantity of maganiferous iron ore mined in Belgium in 1902, the latest year for which official data are obtainable, was 14,440 metric tons, valued at 187,300 francs ($36,149).

The next table gives the annual production and value of manganiferous iron ore mined 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	38,793
1882	345	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.

In the year 1903 the quantity of manganese ore mined in France was 11,600 metric tons, valued at 294,000 francs, obtained in the Departments of L'Ariège and Saone and Loire.

The next table shows the annual production, the total value, and the average value per ton of manganese ores in France from 1886 to 1903, inclusive.

Production and value of manganese ores in France, 1886–1903.

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	1903	11,417	56,742	4.97

GERMANY.

The German Empire in the year 1903 mined 47,994 metric tons of manganese ore, valued at 520,000 marks ($123,760). Of this amount 47,110 metric tons, valued at 463,000 marks, was manganiferous iron ore obtained in Prussia, and the remaining 884 tons of manganese ore came from other sections of Germany.

The annual production of manganese ore in Germany from 1890 to 1903, inclusive, and the production and value of manganiferous iron ores in Prussia from 1881 to 1903, 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	39,698	1898	42,669
1892	32,341	1899	60,360
1893	40,057	1900	58,269
1894	43,012	1901	55,796
1895	40,674	1902	49,025
1896	44,350	1903	47,236

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	38,384	$93,506
1882	4,597	33,745	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	92,050
1887	35,957	228,439	1899	59,425	151,368
1888	26,877	147,250	1900	57,100	157,271
1889	43,311	216,381	1901	54,984	155,652
1890	39,497	174,428	1902	48,110	126,140
1891	36,278	174,624	1903	46,366	110,194
1892	30,892	101,844			

ITALY.

In the year 1903 the Kingdom of Italy, according to the Statesman's Year Book, mined 1,930 metric tons of manganese ore, valued at 58,650 lire ($11,319), and 4,735 metric tons of manganiferous iron ores, valued at 58,714 lire ($11,332).

The next table gives the annual production and value of manganese ores in Italy from 1860 to 1903, inclusive, and of manganiferous iron ores from 1874 to 1883 and from 1892 to 1903, inclusive, except 1895.

Production and value of manganese and manganiferous iron ores in Italy, 1860–1903.

Year.	Manganese ores.		Manganiferous iron ores.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
1860	642	$12,373	....	....
1861	515	9,174	....	....
1862	1,714	15,661	....	....
1863	714	6,674	....	....
1864	712	8,567	....	....
1865	571	6,716	....	....
1866	711	7,191	....	....
1867	677	8,079	....	....
1868	661	7,894	....	....
1869	758	10,403	....	....
1870	630	8,646	....	....
1871	779	9,793	....	....
1872	1,125	12,311	....	....
1873	3,103	46,548	....	....
1874	3,169	58,697	3,445	$6,755
1875	3,750	64,341	19,684	96,500
1876	6,800	61,074	22,878	93,315
1877	6,704	56,546	7,874	26,248
1878	6,550	46,567	6,368	15,297
1879	5,614	33,842	1,366	2,679
1880	6,373	40,682	20,148	63,214
1881	8,629	45,219	[a]29,526	[a]92,640
1882	6,868	67,201	[a]29,526	[a]92,640
1883	11,204	52,975	8,858	27,792
1884	871	7,570	....	....
1885	1,774	10,899	....	....
1886	5,473	30,943	....	....
1887	4,363	21,872	....	....
1888	3,573	15,054	....	....
1889	2,168	9,998	....	....
1890	2,113	10,050	....	....
1891	2,391	12,467	....	....
1892	1,223	8,067	4,549	8,028
1893	797	6,320	8,666	14,445
1894	748	4,536	5,718	8,971
1895	1,544	13,634	....	....
1896	1,860	19,734	9,842	19,300
1897	1,608	14,483	20,926	32,829
1898	2,955	18,052	10,974	25,823
1899	4,287	21,647	29,402	74,449
1900	5,919	29,910	26,377	64,655
1901	2,147	16,052	23,906	58,131
1902	2,438	20,022	22,748	53,384
1903	1,900	11,319	4,660	11,332

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

SPAIN.

Manganese ores of the carbonate and silicate varieties are mined in the Province of Huelva, and exported to foreign countries. Mr. Carl Doetsch, of Huelva, states that in the year 1904, owing to low price, a reduced quantity was exported, the total being 26,895 metric tons. Mr. Doetsch has supplied the next table, showing the total exports from the Province of Huelva by years from 1859 to 1904, inclusive, to have been 1,343,949 metric tons.

Exports of manganese ore from the Province of Huelva, 1859–1904.

Year.	Quantity.	Year.	Quantity.
	Metric tons.		*Metric tons.*
1859–60	27,398	1884	....
1861	1,102	1885	....
1862	6,400	1886	....
1863	18,266	1887	....
1864	20,690	1888	....
1865	24,292	1889	....
1866	31,371	1890	4,720
1867	41,050	1891	3,884
1868	35,306	1892	10,410
1869	20,646	1893	6,394
1870	17,102	1894	7,321
1871	24,297	1895	33,353
1872	27,055	1896	90,821
1873	15,510	1897	103,267
1874	25,588	1898	138,062
1875	13,350	1899	138,419
1876	6,973	1900	129,916
1877	7,295	1901	91,672
1878	36,475	1902	62,944
1879	4,750	1903	54,540
1880	27,572	1904	26,895
1881	4,823	Total	1,343,949
1882	....		
1883	4,020		

As will be seen from the following table, this ore was sent to Belgium, England, France, and Germany, the quantities supplied to each country in the years 1899 to 1904, inclusive, being given:

Exports of Huelva manganese ores, 1899–1904.

Country.	Quantity.					
	1899.	1900.	1901.	1902.	1903.	1904.
	Metric tons.	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*	*Metric tons.*
Belgium and Luxemburg	127,743	126,482	85,951	57,927	53,429	26,023
England	4,842	1,213	918	12	....	145
France	4,449	2,221	2,361	1,823	1,111	707
Germany	1,385	....	2,442	3,182	....	20
Total	138,419	129,916	91,672	62,944	54,540	26,895

PORTUGAL.

Small quantities of manganese ores are obtained in Portugal, principally in the district of Beja, in the Province of Alentejo. Mr. A. G. B. Wilbraham, of Mertola, states that, although none was mined in 1902, there were 30 metric tons, valued at 240,000 reis ($259), produced in 1903.

AUSTRIA-HUNGARY.

Prof. Hans Hoefer states that in 1903 there were 61,789 metric centners of manganese ore produced in the Kingdom of Austria, valued at 128,851 crowns ($26,157).

The next table gives the quantities of manganese ores mined in Austria in the years 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.

In the Kingdom of Hungary the production of manganese ores in 1903, as given by Professor Hoefer, was 124,895 centners, valued at 64,970 crowns ($13,189), and Bosnia and Herzegovina supplied 45,374 centners, valued at 136,122 crowns ($27,633). The following tables give the quantities of manganese ores mined 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	3,976	1901	4,591
1898	8,055	1902	7,347
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	[a] 5,260	1902	5,669
1898	[a] 5,235	1903	4,465

[a] Bosnisches Bureau Montan Abtheilung.

RUSSIA.

The Russian Empire is the largest producer of manganese ore in the world, but owing to disturbed conditions the returns are late.

In the "Bulletin Russe de Statistique Financière et de Législation, 1904," the quantity of manganese ore exported (probably from the Caucasus district) is given as 27,499,000 poods in 1902 and 28,004,000 poods in 1903, approximately 443,374 and 451,464 long tons.

SWEDEN.

The official statistics of Sweden show that in the year 1903 there were mined 2,244 metric tons of manganese ore, valued at 36,550 kroners ($9,795).

The following table gives the statistics of the production and value of manganese ore in Sweden for the years 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	2,209	9,795

TURKEY.

Manganese deposits exist in Turkey, all of the ore won being exported. Mr. Hugh Whittall, of Constantinople, states that the ministry of mines reported the exportation of manganese ore from Turkey in the year 1903 as 49,100 tons, valued at 66,950 pounds.

GREECE.

Moderate quantities of manganese ores are mined in Greece, the total for the year 1902 being 14,962 metric tons, valued at 448,860 francs. Considerable quantities of manganiferous iron ores are also mined.

INDIA.

Although manganese ore has long been known to exist in India, it is only within the last decade that this ore has been mined in quantity. The main source of supply is in the Madras Presidency at Vizagapatam, but ore is also obtained in the Bombay Presidency and the Central Province, while the mineral which occurs in other localities is not worked. Mr. L. Robertson, secretary to the government of India, states that the production of manganese ore in India in 1903 was 165,006 long tons, valued at 1,991,117 rupees ($645,123), that being the maximum annual output.

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]	162,057
1897	73,680	1902 [a]	157,780
1898 [a]	60,449	1903 [a]	165,006

[a] Production.

JAPAN.

Moderate quantities of manganese ore are mined in Japan. In the following table the first column gives the production of manganese ore from 1886 to 1902, inclusive, as taken from the Financial and Economical Annual of Japan, while the second column shows the exports of this mineral from 1881 to 1904, inclusive, together with the value from 1893 to 1904, and is from the annual returns of the Empire of Japan (department of finance). As both sets of figures are claimed to be official, no attempt has been made to harmonize them.

The exports of manganese ore in 1904 are given as 5,779,341 kin,[a] valued at 88,448 yen ($44,047). Of this quantity 5,222,788 kin were exported from Yokohama and 556,553 kin from Kobe.

[a] Kin taken at 1.31 pounds.

Production and export of manganese ores, Japan, 1881–1904.

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	10,592	2,625	....
1891	3,142	3,178	....	1903	....	3,258	38,791
1892	4,891	4,948	....	1904	....	3,380	44,047

JAVA.

No late reports are at hand in regard to the production of manganese ore in Java, the exploitations being in the regencies of Pengasin and Mangolaen. In 1899 the amount mined was stated to be 1,388 metric tons.

NEW ZEALAND.

In the year 1901 the production of manganese ore was 208 long tons, valued at £614 ($2,988); in 1902 no ore was mined, and in 1903 the production was 70 tons, valued at £210 ($1,023).

AUSTRALIA.

NEW SOUTH WALES.

No manganese has been mined in this province since 1901, when the production was 12 tons.

QUEENSLAND.

The manganese deposits of the central and southern districts of Queensland are described by Mr. Lionel C. Bell in a report on "Certain Iron Ore, Manganese Ore, and Limestone Deposits." Mr. Bell states that the area within which manganese ore has been found in the Gladstone district is, roughly, 15 miles in greatest length and 12 miles in greatest width, from Targinie on the northwest to Calliope on the south and Quoin Island on the east.

The manganese area consists of massive slates, quartzites, jasperoids, and sandy clay schists, variously intersected by dikes of trachyte, syenite, and diorite. The only other formations are the river and estuarine alluvials.

The typical surface country for manganese is hard, flinty, red or brown, sometimes quartz-veined jasperoid clay slate, indurated and colored, owing to partial or complete replacement by silica and oxides of iron. These indurated rocks pass at from 20 to 50 feet depth into soft brown or yellow clay slate (or schist) or bluish quartzite.

The deposits are lenticular, lying, with very few exceptions, with their longer axes parallel to the bedding of the slates. As a rule the outcrop is small, and the work thus far points to the depth of the lenses being no greater than their greatest length. There will probably be a number of overlapping lenses, extending to some depth, and only prospecting can determine whether these occur near enough to one another to be profitably worked.

There can not be doubt as to the secondary nature of most of the ore. The ore deposits may be considered to form belts running about north and south, with a tendency toward north-northwest—i. e., parallel to the strike of the country.

The Mount Miller mine, now producing ore, has been worked for eight years. The original outcrops have been quarried, but the mine is now worked underground. The ore body is irregular in strike, dip, and thickness, the average strike being north and south, and the dip vertical. The thickness of clean ore varies from 3 to 21 feet.

The typical ore, chiefly psilomelane, but containing pyrolusite and probably also braunite, is massive and mostly steel-gray, passing into dull bluish in bands and patches. It is sometimes honeycombed and then the cavities are lined with a dead black deposit of binoxide.

The present ores may pass into carbonates at depth, though no trace of such has yet been found.

A number of analyses made by the Government show as follows:

Analyses of Queensland manganese ores.

	Per cent.
Manganese	30.3 to 48.7
Iron	1.2 to 7.2
Silica	5.8 to 15.3
Phosphorus	Trace to 0.11
Sulphur (one determination)	Trace.

The average of the mine product in 1903 showed 74.1 per cent of manganese dioxide.

Manganese also occurs at Auckland Hill. The main workings are on the west, but one shaft has been sunk on the north, and it demonstrated the existence of ore. The ore occurred in bunches of up to 20 or 30 tons, connected by stringers. There is no doubt that ore has there replaced slate.

The ore is massive and consists of a mixture of psilomelane, pyrolusite, and braunite. It has a submetallic luster and steel-gray color with brown streaks.

A sample of shipping ore analyzed by the Government gave:

Analysis of manganese ore from Auckland Hill, Queensland.

	Per cent.
Manganese dioxide	69.4
Silica	7.6
Iron	2.2
Phosphorus	.33
Sulphur	Trace.
Manganese	46.7

Manganese deposits are found at Morgan and Reid's, about 8 miles west of Gladstone, and at Boat Creek, 7 miles west of Gladstone; at Shaw and Morris, about 3½ miles from Calliope; at Cairncross, 4 miles northeast of Calliope; at the old workings at One Tree Hill; at Gardiner's, near Calliope; at Torbeck's, 1 mile southeast of Mount Beecher; at Mount Crosisco, 8 miles south-southwest of Gladstone; and at Targinie and the islands in Port Curtis.

There are also several manganese deposits in the district between Rockhampton and Emu Park, the main workings being at Coorooman, Gin Gin, and Deglibo. In the Ipswich district, in the northern part of the parish of Kholo, deposits of manganese ore occur from 6 to 9 miles north of Ipswich, all within 3 miles of the Brisbane River. The outcrops are distributed over an area of 6 square miles, and the ore as a whole is freer from clay than that at Gladstone. It is found at Dandy's Knob, in portions 12, 31, 32, 56, 69, 71, 73, 91, 122, and 124, but has only been worked at portion 91.

Manganese also occurs in the parish of Rosenthal, and at Mount Gammie, in the Darling Downs district.

Analysis of manganese ores in central and southern districts of Queensland.

	Manganese dioxides.	Manganese.	Iron.	Silica.	Phosphorus.	Sulphur.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Morgan and Reid's	66.43–72.70					
Boat Creek	65.5 –70.8					
Shaw and Morris's	69.5	46.7	2.7	4.5	0.14	
Gardiner's	43.6	29.7	22.1			
Torbeck's	54.4	37.7				
Portion 56		42.4	.67	27.6		
Portion 91	64.8	42.7	.56	17.7	.13	Trace.

In 1903 there were mined in Queensland 1,320 long tons of manganese ore, valued at £5,332 ($25,967). The following table shows the quantities of manganese ore produced annually in Queensland from 1881 to 1903, inclusive:

Production and value of manganese ores in Queensland, 1881–1884 and 1889–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1881	87	$1,263	1895	355	$5,387
1882	100	1,694	1896	300	4,380
1883	20	290	1897	300	5,475
1884	55	799	1898	67	1,221
1889	4	87	1899	735	13,775
1890	5	97	1900	75	998
1891	10	126	1901	218	3,869
1892			1902	4,600	82,677
1893			1903	1,320	25,967
1894	140	1,936			

WORLD'S PRODUCTION OF MANGANESE ORES.

Contemporaneous data of the production of manganese ores in various countries can not be secured, but the following table presents the latest reliable statistics obtainable, in connection with the year which the figures represent. The tons are either long or metric tons.

The world's production of manganese ores.

Country.	Year.	Quantity.	Country.	Year.	Quantity.
North America:		*Tons.*	Europe—Continued.		*Tons.*
United States	1904	3,146	Italy	1903	1,930
Canada [a]	1904	110	Portugal	1903	30
Cuba [a]	1904	15,516	Russia	1903	[b] 451,464
South America:			Spain	1904	26,895
Brazil [a]	1903	159,369	Sweden	1903	2,244
Chile [a]	1902	12,785	Turkey [a]	1903	49,100
Europe:			Asia:		
Austria	1903	6,179	India	1903	165,006
Bosnia and Herzegovinia	1903	4,537	Japan	1902	10,592
Hungary	1903	12,490	Java	1899	1,388
France	1903	11,600	Oceania:		
Germany	1903	47,994	Queensland	1903	1,320
Greece	1902	14,962	New Zealand	1903	70

[a] Exports. [b] Not official, probably only Caucasus district.

GOLD AND SILVER.

By Waldemar Lindgren and Others.

INTRODUCTION.[a]

The Geological Survey obtains its data of the production of gold and silver by direct returns from the mines, and it is desired to acknowledge in this place the hearty cooperation of the mine owners, large and small producers, throughout the country. Without this cooperation the proposed plan would have been a failure; with it, it is believed that the report reflects an accurate picture of the conditions of the industry, scattered as the output is among over 3,000 producing mines. The number of mine owners who have refused to report their production is extremely small, and the few that still persist will doubtless reconsider when they clearly understand that the figures given are wholly confidential, that only totals of States, counties, and districts are given, and that in the case of single producers in counties and districts their production is so reported as to conceal the exact amount of their output. It should be added that a very large and growing number of companies no longer make a secret of their production of gold and silver. The data collected by this method, however diligently, are apt to be slightly lower than the actual figures for the reason that it is very difficult, if not impossible, to obtain the output of individuals who perhaps only do some placer work during the wet season and return to other avocations during the rest of the year. This applies especially to Chinese and other alien miners, from whom, as a rule, no information can be secured in any case. These reasons explain why the figures of the Director of the Mint, which are derived chiefly from direct returns of the United States mints and assay offices and from smelting and refining works, are apt to be slightly higher than those here published, though a comparison will show that this is by no means always the case. On the other hand, it is impossible to secure from the sources just enumerated such reliable data as to the production of counties and individual districts as are

[a] The writer was given charge of the collection of gold and silver statistics on July 1, 1904. The short time available may in part excuse the lack of detail in the report and a certain lack of a comprehensive plan in the reports of special agents and assistants.

afforded by the method of the Geological Survey, by means of which the progress of the industry can be accurately gaged; neither is it possible, without such data, to classify properly the gold and silver ores according to the plan outlined in this report and to ascertain the tonnage and average contents of those ores.

UNIT OF MEASUREMENT.

The standard unit for ore production adopted is the short ton of 2,000 pounds. Gold and silver are measured by the fine ounce, and the average commercial price of silver during 1904 is considered to be from 57 to 57.843 cents per ounce, the figure varying slightly in the several State reports.

In addition to gold and silver, data have been obtained for the production of copper, lead, zinc, and for several States at the following prices for 1904: Copper, at 12 to 13 cents per pound; lead, at 4.30 to 4.375 cents per pound; zinc, at 5 cents per pound.

Crude platinum is valued at from $12 to $15 per ounce. It should be understood that in most cases, owing to high reduction charges, the miner failed to obtain these prices for his product.

PRODUCTION.

The production of gold in the United States for 1904 reported by the mines to the Geological Survey was 3,910,729 fine ounces, of the value of $80,835,648. This represents an increase of $7,243,948 over the production of 1903 as given by the Director of the Mint. After a period of very rapid advance in the gold production from 1892 to 1900, during which an increase from $33,000,000 to $79,171,000 took place, there followed two years of nearly stationary output and one year, 1903, of very decided decrease. It is therefore very gratifying to find that the production has risen again with a bound to record figures, the largest previous output in 1902, according to the figures of the Director of the Mint, amounting to $80,000,000.

The production of silver in 1904 reported by the mines to the Geological Survey was 55,999,864 fine ounces, of a value of $32,035,378. This represents an increase of 1,699,864 ounces over the production of 1903, as given by the Director of the Mint, and an increase in value of $2,713,378. There is, therefore, a total increase of $9,957,326 in the value of gold and silver produced in 1904 over that of 1903. The record output of silver in 1892, amounting to 63,500,000 fine ounces, has not been reached in late years, nor has the commercial value attained the figures of that year, which amounted to $82,101,000. The price of silver in 1904, according to the Director of the Mint, varied from 55 to 61 cents per fine ounce, representing a decided increase over the prices of 1903, which varied from 48 to 59 cents and only exceptionally rose to 61 cents in October, 1903.

The number of fine ounces and the value of gold and silver reported by the mines in 1904 are shown in the appended table. As the service of the Geological Survey is as yet not fully organized in Alaska and in the Southern and Eastern States, figures of the Director of the Mint have been used for these districts.

The following table shows the production of gold and silver in 1904, by States and Territories. The data have been obtained by direct returns from the mines, except as noted.

Production of gold and silver in 1904, by States and Territories.

[Fine ounces.]

State and Territory.	Gold.		Silver.		Comparison by value with production of 1903 (increase, +; decrease, −).	
	Quantity.	Value.	Quantity.	Value.	Gold.	Silver.
Alaska [a]	443,177	$9,160,458	193,695	$110,405	[b] +$476,893	[b] −$4,049
Arizona	168,274	3,478,532	2,314,940	1,325,303	+748,708	+198,642
California	901,484	18,633,676	1,480,589	843,936	+2,333,023	+345,524
Colorado	1,183 518	24,463,322	13,947,635	7,985,028	[b] +1,923,222	[b] +970,320
Idaho	82,739	1,710,365	7,666,382	4,389,004	+349,246	+437,214
Kansas					[b] −9,700	[b] −52,596
Michigan [c]			122,807	70,000		[b] +43,000
Montana	206,419	4,267,062	12,817,285	7,334,146	[b] −144,838	[b] +507,304
Nevada	244,823	5,060,494	4,268,123	2,432,830	+1,990,144	+333,918
New Mexico	18,476	381,930	214,553	124,103	+112,307	+15,047
Oregon	68,321	1,412,186	132,077	75,284	−22	+13,043
South Dakota	356,264	7,363,977	161,611	92,522	[b] +537,277	[b] −26,926
Texas	9	186	385,576	213,935	+186	[b] −31,441
Utah	202,675	4,189,292	12,049,446	6,898,308	−154,777	+380,157
Washington	15,214	314,463	157,598	89,831	−193,422	−111,958
Wyoming	837	17,305	4,647	2,661	[b] +13,705	[b] +2,553
Southern Appalachian States	18,499	382,400	82,900	48,082	[b] +130,000	[b] +29,614
Total	3,910,729	80,835,648	55,999,864	32,035,378	[d] +8,111,952	[d] +3,049,366

[a] From the report of the Director of the Mint for 1904.
[b] Compared with the figures of the Director of the Mint for 1903.
[c] Estimate.
[d] Based on combined data of the Director of the Mint and of the Geological Survey.

The principal sources of the great increase in the gold production of over $7,000,000, compared with that of 1903, are easily traceable. Colorado added nearly $2,000,000 to her production of 1903, most of which was derived from the mines of Cripple Creek. Nevada's output increased about the same amount, chiefly due to the phenomenal yield of the Goldfield mines. The greatest progress is reported in California, whose production exceeds that of 1903 by $2,300,000, the increase being partly caused by a strong development of the quartz-mining industry and to a less degree by the activity of the dredgers. Alaska and Arizona show increased yields, amounting, respectively, to $476,893 and $748,708. A number of States show smaller increase, while Utah, Montana, and Washington have less gold to their credit in 1904 than in 1903.

The increase of value in the production of silver of $2,713,378 is somewhat evenly distributed among the various States and Territories, but is to some extent due to the better price of silver obtained. Colorado leads with an increase of $970,320. California, Idaho, Montana, Nevada, and Utah also added considerable value to their silver production.

Reviewing the figures in more detail, it should be stated that the moderate increase in the production of Alaska is chiefly due to an increase in the production of the quartz mines. Nome slightly reduced its output, which is estimated at $4,064,604. The quartz mines on the coast are as a rule in a flourishing condition and yielded $3,050,977. The yield of silver is comparatively unimportant.

Arizona's increase of 748,708 is chiefly derived from siliceous ores from Yavapai, Mohave, and Yuma counties, while the reopened Tombstone mines have contributed their quota from Cochise County, more than compensating for the closing down of some properties. The increase in the production of silver is chiefly due to copper and siliceous ores of Yavapai County.

No State showed a greater increase in the production of gold than California. Its output for 1904 was $18,633,676, or $2,333,023 more than in 1903. The gold-producing area is extremely large, and includes 34 counties out of 57. It literally extends "from Siskiyou to San Diego and from the Sierra to the sea." Seven counties produced each over $1,000,000 and two produced over $2,000,000. Nevada County very nearly reached the $3,000,000 mark; Amador and Calaveras come next. Quartz mining in the five mother-lode counties—Eldorado, Amador, Calaveras, Tuolumne, and Mariposa—resulted in an output of $5,940,238 in gold. An increase is shown in all branches of gold production, but chiefly in quartz mining and dredging. The latter was responsible for an increase of $711,289, but the activity in quartz mining resulted in an increase of nearly double this figure, or $1,400,494. The sum of $13,648,386 was produced from quartz mining and $2,187,038 from dredging.

The production of silver in California, while never very great, shows an increase of about 400,000 ounces over that of 1903. This is chiefly due to renewed activity in copper smelting in Shasta County.

Colorado shows an increase of $1,923,222 in gold, compared with the figures of the Director of the Mint for the previous year. About $1,500,000 of this increase was derived from Cripple Creek, which has a production of $14,504,350 for 1904. The remainder comes from the large mines in San Miguel County, while in the Gilpin district, including Gilpin, Clear Creek, and Boulder counties, the production is about stationary. The gold output of Leadville district also remains about the same as in 1903, the figures for 1904 being $1,175,841.

Silver mining remains in a healthy condition, though most districts reported a slight decrease compared with 1903. Leadville produced 4,820,596 ounces, of which 1,703,985 ounces were derived from zinc or zinc-lead ores, and Pitkin County (Aspen) produced 2,150,035 ounces. A considerable increase appeared from the San Juan County district, especially in San Miguel and San Juan counties.

Idaho derived $349,246 more from its gold mines than in 1903. The placer yield amounted to $493,002, or about $100,000 more than in 1903. Of this, approximately $32,000 was obtained from the Snake River sands. The Boise basin and the old placer districts in Idaho County are still the largest producers. The principal increase comes from siliceous ores in the Silver City district, Owyhee County; Buffalo Hump and Thunder Mountain districts, in Idaho County, and from various districts in Lemhi County.

The silver product increased by 267,412 ounces, divided between the lead ores of the Cœur d'Alene and the Wood River district and the siliceous ores of the Owyhee fissure veins. The greatest increase, of 154,000 ounces, is reported from the Wood River district. The Cœur d'Alene district produced 6,069,918 ounces.

A small quantity of silver, estimated at $70,000, is obtained as a by-product in the refining of certain grades of Lake Superior copper and is credited to Michigan.

In Montana there is apparently a decrease in the production of gold when compared with the figures of the Director of the Mint for 1903. Of the production, amounting to $4,267,062, more than $1,000,000 is derived from the cyaniding ores of Fergus County, which recently have attained great prominence. The Butte copper mines contribute $971,046, which appears to be a slight decrease from the figures for 1903. Madison and Lewis and Clarke counties follow next, and only smaller amounts are contributed by the other counties. The most important placers are contained in Madison County, and 20,566 ounces, or about the same amount as from Idaho, were derived from the placers. Of the silver, the production of which has increased by $507,304 compared with the output of 1903, by far the largest part, or 10,530,582 ounces, is produced by Silverbow County. Granite County comes next, with 1,293,296 ounces, a considerable part of which is derived from the siliceous ores mined by the Granite-Bimetallic Company.

Nevada is one of the States of large increase. The production of gold reached $5,060,494 in 1904, an increase over the preceding year, according to the figures of the United States Geological Survey, of $1,990,144. Practically the whole of this increase should be credited to the new camp of Goldfield, in Esmeralda County, which produced somewhat over $2,300,000 during the year. Lincoln County, which includes the Searchlight and De Lamar districts, showed a slight increase, but many of the minor counties produced less in 1904 than in 1903. The output of the Comstock mines increased, however, by several hundred thousand dollars over that of 1903, the Ophir mine being the principal producer.

The returns from silver producers indicate an increase of $333,918, of which the greater part is derived from the Comstock mines. Tonopah remains very productive, with an output of about $1,230,000 of silver, commercial value.

In New Mexico the gold production of the year was $381,930, an increase of $112,307 over 1903, which is largely derived from the Rosedale district, in Socorro County, and the Hillsboro district, in Sierra County. Small decreases are reported from the other counties, including Grant County with the old Silver City district. The placers yielded $149,424. A small increase is noted in the unimportant silver production. Most of the added supply came from Socorro County, while the other counties produced somewhat less than in 1903.

The State of Oregon shows a stationary gold production of $1,412,186, of which about one-third is derived from the southern part of the State and the remainder from the Blue Mountains, in the northeastern part of the State. Baker County, in which the important Cracker Creek mining district near Sumpter is located, led in production, with $738,973, of which $51,855 was derived from placers. The old mining camps of Cornucopia, Connor Creek, and Virtue produced very little. In the southern part of the State, including Jackson, Josephine, Lane, and Douglas counties, the production is scattered among a great number of small placer and quartz mines. The placers of the State produced $349,214, three-fourths of which amount came from the counties in southern Oregon.

The silver output of Oregon is unimportant and principally derived from Baker and Grant counties, in the northeastern part of the State.

South Dakota produced within a small territory in the Black Hills gold to the value of $7,363,977, an increase of more than $500,000 over 1903. As is well known, the industry is based on the mining on a large scale of low-grade amalgamating ores of the Homestake type and of likewise siliceous ores of higher grade which are reduced by cyaniding or smelting. The plant at the Homestake mine was still further increased, so that 1,000 stamps are now dropping on that property. Many additions have been made to the cyanide plant treating the refractory ores. A total of 48 mines crushed 1,804,935 tons of ore, of an average value of $4.08 per ton. From placers were derived $3,614. The free-milling ores yielded $4,775,925, the cyaniding ores $2,541,104. In addition, $131,051 were obtained from siliceous ore by smelting, and a small amount from smelting of lead and copper ores.

The silver production of Texas, estimated for 1904 at 385,576 fine ounces, is to a large extent derived from the mines of the Presidio Mining Company at Shafter, Presidio County. The ores carry silver chloride, and pan amalgamation is the process used.

In Utah the gold product decreased $154,777 in value, and amounted to $4,189,292. A decrease of about 20,000 ounces in Tooele County, in which is situated the Camp Floyd district of cyaniding ores, is largely responsible for this, but the decrease is to a large extent counterbalanced by the increased output of Salt Lake and Juab counties, in which are situated the Bingham and Tintic camps. The growth of the Bingham Camp is especially remarkable. The Tintic district increased its output of gold chiefly from lead and copper ores by 6,510 ounces, the camp yielding 71,967 ounces, and Bingham by 13,925 ounces, the camp yielding 56,390 ounces. The placer production of Utah is insignificant.

The silver production of Utah shows a loss of 154,565 ounces, but on account of higher prices paid for the metal the value increased $380,157. The State produced a total of 12,049,446 ounces, being third in rank after Colorado and Montana. The decrease is due to smaller shipments from the Park City mining district, Summit and Wasatch counties yielding 5,814,386 ounces, against 7,109,209 ounces in 1903.

A large increase is reported from the Tintic district, which yielded 3,938,630 ounces, and from Bingham, which produced 1,440,213 ounces. The total output of the Tintic district in 1904 is thus 71,967 ounces of gold and 3,938,630 ounces of silver, while Bingham produced 56,390 ounces of gold and 1,440,213 ounces of silver.

The State of Washington produced less gold than in 1903, the decrease amounting to $193,422, with a total production of $314,463. This is explained by the idleness of several large mines in Ferry, Chelan, and Okanogan counties. In Ferry County alone the decrease—chiefly in the Republic district—was over $162,000, and seems largely due to the difficulty of treating the ores which do not yield readily to amalgamation or cyaniding, while their very siliceous character makes them undesirable for the smelters. That the State did not show a still greater loss is due to the Mount Baker district, in Whatcom County, which increased its yield from $36,388 in 1903 to $115,000 in 1904. The output of silver in Washington is small and mainly derived from the lead ores of Stevens County as well as from the siliceous ores of Whatcom and Ferry counties.

Wyoming is one of the least important States in the production of gold and silver, having only produced $17,305 in gold and $2,661 in silver during 1904. More than one-half of the gold output is derived from Fremont (Atlantic City district), Crook, and Johnson counties, in order of importance stated. The remainder is chiefly derived from copper ores, low in gold, occurring in Albany and Carbon counties. The placers of Crook County yield a small amount.

According to the Director of the Mint, the Southern Appalachian States, comprising Maryland, Virginia, North Carolina, South Carolina, Georgia, Alabama, and Tennessee, have the following amounts to their credit for 1904:

Production of gold and silver in Southern Appalachian States in 1904, by States.

[Fine ounces.]

State.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
Alabama	1,417	$29,300	200	$116	$29,416
Georgia	4,688	96,900	1,500	870	97,770
Maryland	116	2,400	....	....	2,400
North Carolina	5,994	123,900	14,800	8,584	132,484
South Carolina	5,892	121,800	500	290	122,090
Tennessee	208	4,300	59,200	34,336	38,636
Virginia	184	3,800	6,700	3,886	7,686
Total	18,499	382,400	82,900	48,082	430,482

Compared with 1903, an increase of gold of $130,000, and of silver of $29,614, is shown.

The production of the Southern States is extremely scattered, considering its small amount. Virginia contributes from 11 counties, North Carolina from 32, South Carolina from 12, and Georgia from 26 counties. The output has remained approximately stationary for many years. Smelting ores furnish only a small fraction of the gold product, but in late years an increasing quantity of silver is obtained as a by-product from the electrolytic refining of copper from Tennessee, as well as from shipping ores from Virginia and North Carolina. The placers yield only about one-eighth of the total production of gold, and by far the largest part is derived from siliceous ore of low grade with free gold. Some of the ores—for instance, those of the Haile mine in South Carolina—are likewise siliceous, but contain little or no free gold, and are treated by concentration and chlorination. Others are cyanided with varying results, and some mines ship their concentrates to the smelters.

Lumpkin County, in Georgia, containing the Dahlonega district, Montgomery and Stanley counties, in North Carolina, and Lancaster County, in South Carolina (Haile mine), are the only ones among the many producing counties in which the output of gold exceeded $10,000.

NUMBER OF MINES.

The number of producing mines in the Western States, exclusive of Alaska, as reported to the United States Geological Survey in 1904, was 3,239. To this should be added several hundred producers in Alaska and probably over a hundred in the Southern Appalachian States, which would make a total of about 4,000. A source of comparison is obtained from the special reports of the Census Bureau for 1902, in which the total is given as 2,992.[a] This is exclusive of Alaska placers. The total number of placer mines as reported to the Geological Survey for 1904 is 1,334 and of deep mines 1,905. Colorado has the largest number (567) of deep producing mines, and is followed by California with 474. In number of placer mines, California easily leads with 711, and is followed by Idaho with 248 and by Oregon with 211 mines. California has by far the greater number (1,185) of producing mines, and is followed by Colorado, in which the number is 588.

Number of reporting gold and silver mines in the Western States, exclusive of Alaska, in 1904.

State.	Producing deep mines.	Producing placer mines.	Reporting, but nonproducing mines.
Arizona	97	7	644
California	474	711	1,555
Colorado	567	11	(a)
Idaho	112	248	703
Montana	137	73	102
Nevada	143	15	495
New Mexico	80	24	64
Oregon	84	211	520
South Dakota	48	16	(a)
Utah	110	2	604
Washington	45	9	553
Wyoming	8	7	412
Total	1,905	1,334	....

a Not reported.

TONNAGE.

The deep or lode mines producing gold and silver in the Western States and Territories, including Alaska, had a tonnage of 19,229,746 short tons of ore in 1904. The following table gives the tonnage of each State as reported to the United States Geological Survey, Alaska alone being estimated; it also gives the average value per ton of gold and silver contained in the ores. It will be seen that Montana is in the lead as to tonnage, closely followed by California, Colorado, and Arizona. To fully illustrate the condition of the industry, the tonnage

a Special Reports of the Census Office: Mines and Quarries, 1902, p. 59.

should be further subdivided into various classes of ores, and this will be done in the future.

The average values given need some explanation. Milling ore, especially gold ores, can be mined and treated at low cost, so that $2 or $3 per ton may under circumstances yield a profit. States like California, in which milling ores predominate, are therefore likely to show low average values. On the other hand, smelting charges, usually combined with shipping charges, are high, and States yielding gold and silver ores which must be shipped and treated by the smelting process are apt to show high averages, as do, for instance, New Mexico and Nevada. Finally, much gold and silver is derived from copper or lead ores which contain a very small amount of precious metals, and which would not pay to mine and mill for these alone. As a large tonnage is usually produced in these operations—for instance, in the Coeur D'Alene lead mines in Idaho or in the Butte copper mines in Montana—the effect will be to reduce greatly the average tenor of gold and silver in the ores of the State. Thus Montana shows an average value of only $2.50 per ton in gold and silver, and similar averages obtain in Idaho and Wyoming. The States showing the highest average values are Nevada, New Mexico, and Colorado. The average for Nevada, $23 per ton, is exceptional, and is due to high values of ores from Goldfield, the Comstock, and the Searchlight, as well as to the absence of large quantities of low-grade milling and copper-lead ores.

Production of ore from deep mines producing gold and silver in Western States and Territories; and average value of gold and silver per ton, by States.

[Short tons.]

State.	Quantity.	Average value of gold and silver per ton.	State.	Quantity.	Average value of gold and silver per ton.
Alaska[a]	1,300,000	$2.35	Oregon	121,189	$9.40
Arizona	2,305,938	2.08	South Dakota	1,804,935	4.13
California	2,782,438	5.21	Texas	19,796	10.80
Colorado	2,333,881	13.84	Utah	1,716,947	6.46
Idaho	1,668,327	3.36	Washington	59,311	6.65
Montana	4,643,092	2.41	Wyoming	42,114	.42
Nevada	323,672	23.15	Total	19,229,746	5.19
New Mexico	108,106	3.48			

[a] Estimated.

CLASSIFICATION OF ORES.

At first glance the classification of gold and silver ores seems a matter involving no great difficulties, but on closer approach many complications are perceived, owing to transitions between various classes. It is hoped that a more complete and more satisfactory scheme will be produced for the year 1905. For 1904 the following plan has been adopted. The gold and silver product is classified according to its derivation from placers, dry or siliceous ores, lead ores, copper ores, and zinc or zinc-lead ores.

The placers include the sluicing, hydraulic, dredging, and drifting processes.

The smelters designate as dry ores those with less than 5 per cent lead, which usually are chiefly valuable for their gold and silver. Under the heading of dry or siliceous ores are included quartzose gold and silver ores with less than 4½ per cent lead or 3 per cent copper, which are usually treated by amalgamation or cyanide process. But it is also necessary to include with them certain low-grade ores which are less clearly quartzose in character, such as the calcareous cyanide ores of Fergus County, Mont. Ores with over 4½ per cent lead are designated as lead ores, and ores with over 3 per cent copper as copper ores. In the latter case the difficulty is that small parcels of gold and silver ores which contain 3 or 4 per cent of copper ore are not considered as copper ores by the smelters, and no pay is obtained for the metal; while, on the other hand, in some very large pyritic copper mines, as in Butte, Mont., the grade of the regular ore is apt to sink below 3 per cent copper. Those ores are classed as zinc ores, which are chiefly valuable for the zinc contained, or, if they contain both lead and zinc, those in which the value of zinc predominates over that of the lead. They are usually lacking in gold and poor in silver. The greatest difficulty is presented by the Leadville ores, which contain gold, silver, copper, and lead, and often not enough of any one of these metals to pay for reduction. It is often a matter of doubt as to whether such an ore should be classed as dry and siliceous ore, as lead ore, or as copper ore. Concentrates of regular dry and siliceous ores, even if containing lead or copper, are not considered as lead or copper ores, because the classification is based on the quality of the ore as mined.

DISTRIBUTION OF GOLD PRODUCT OF 1904.

Gold from placers.—The placer gold obtained in 1904 was to the amount of 612,631 fine ounces, equivalent to $12,664,206.

Alaska and California are of course the largest producers. With an output of 290,276 ounces, nearly one-half of the total, Alaska shows a small loss in placer gold compared with 1903, in spite of greatly increased output from the Tanana diggings. California has gained much more in placer yield compared with 1903, in fact 45,115 ounces, or $932,529. This is chiefly due to dredging, the amount derived from this industry increasing steadily from $200,000 in 1900 to $2,187,038 in 1904. The principal productive area extends from the Klamath

River on the north down to Tulare County on the south, along the eastern side of the great valley.

Idaho, Montana, and Oregon rank after Alaska and California. Idaho produced 23,849 ounces in 1904, equivalent to $493,002, an increase of 5,621 ounces. Oregon, on the other hand, shows a decrease of about 6,000 ounces, the total production amounting to $349,214. In these two States gold is obtained from the old districts in southern and eastern Oregon, and from the Boise basin and Idaho and Lemhi counties in Idaho. Montana maintains a steady production of about 20,000 ounces, chiefly from Madison County.

Colorado and New Mexico, each with a production of about 7,000 ounces, are the only remaining States of importance in regard to this class of mining. In Colorado dredging at Breckenridge (Summit County) is a principal source, although placers are also worked in San Miguel, Clear Creek, and Gunnison counties. In New Mexico the dredgers at Elizabethtown, in Colfax County, yielded well, and some gold was also derived from new diggings in Sierra County.

Gold from dry and siliceous ores.—Nearly 3,000,000 ounces, or three-fourths of the total output, of gold is derived from dry or siliceous ore, thus bearing testimony to the great affinity of gold for quartz. Most of the placer gold results from the erosion of gold-quartz veins.

Colorado still occupies the first place with a notable increase in production from the two centers of Cripple Creek and the San Juan mountains, while the Gilpin region holds its own. It was the only State producing over 1,000,000 ounces from this source. Next in importance comes California, the quartz veins of which yielded $1,400,000 more than in 1903. South Dakota has increased its output from siliceous ores in the Black Hills by $500,000, and Nevada by $2,000,000. The other States follow in the rank mentioned: Montana, Alaska, Arizona, Utah, Idaho, and Oregon, and in all of them, except Utah and possibly Montana, a decided increase is shown.

The yield from quartz mines on the Alaskan coast shows an increase of over $300,000 over the figures of 1903.

Gold from lead ores.—Very little gold is derived from lead ores, the total only amounting to 122,342 ounces. The most important State from this point of view is Colorado, in which 70,641 ounces were produced chiefly from ores from Leadville and San Juan County. Next comes Utah, in which the Tintic mines are largely to be credited with an output of gold from this source. The third rank is occupied by Arizona, which furnishes gold from lead ores of Pima County and of the Tombstone district in Cochise County. None of the other States are of much importance.

Gold from copper ores.—A little more gold is obtained from copper ores than from lead ores, but the total production is only 230,442 ounces. In this respect Utah leads with 109,968 ounces, again largely from the Tintic mines. Arizona follows with 47,563 ounces derived from copper ores in Cochise and Yavapai counties, a large increase over 1903. Montana occupies third rank, and the Butte copper mines in that State are the source of about 44,000 ounces. California adds 24,727 ounces to the total, principally from the Shasta copper mines. Colorado yields only 3,288 ounces from copper ores properly speaking, although, as mentioned above, a large tonnage of the Leadville and San Juan County ores might be considered as low grade lead-copper ores.

Gold from zinc ores.—To Leadville, Colo., 4,697 ounces of gold have been credited from zinc and zinc-lead ores. As a general rule zinc ores are poor in gold, and in this case the gold is perhaps rather associated with galena than with the zinc blende.

Source of gold in 1904 in Western States and Territories by States.

[Fine ounces.]

State.	Placers.	Dry and siliceous ores.	Lead ores.	Copper ores.	Zinc ores.
Alaska[a]	290,276	152,901			
Arizona	815	107,211	12,685	47,563	
California	241,185	635,547	25	24,727	
Colorado	7,022	1,097,870	70,641	3,288	4,697
Idaho	23,849	58,252	100	538	
Montana	20,566	139,282	2,131	44,440	
Nevada	1,461	240,775	2,577	10	
New Mexico	7,228	6,861	250	4,137	
Oregon	16,895	51,100		326	
South Dakota	175	355,914	30	145	
Texas			9		
Utah	66	58,747	33,894	109,968	
Washington	475	14,157		582	
Wyoming	108	403		326	
Southern Appalachian States[a]	2,500	14,933		1,066	
Total	612,621	2,933,953	122,342	237,116	4,697

[a] Estimated.

DISTRIBUTION OF SILVER PRODUCT FOR 1904.

Silver from placers.—Silver is only a subordinate product of placers, but the quantity derived from this source is ordinarily underestimated, because it is so often omitted in the returns from the mines.

Silver from dry and siliceous ores.—A little less than one-third of the total quantity is derived from these ores, to which Colorado, Nevada, and Montana contribute the largest quantities, the first-named State leading with over 7,000,000 ounces. Certain low grade ores of Leadville have been classed in this division with some doubt; should they be considered as lead and copper ores, the total from this source would be reduced from 16,000,000 ounces to about 15,000,000 ounces.

Silver from lead ores.—Nearly one-half of the total, or about 22,000,000 ounces of silver, is derived from smelting of lead ores. In this class Utah is first with over 9,000,000 ounces, chiefly due to the production of the veins of Park City and Tintic districts. Idaho comes next with 6,500,000 ounces, largely derived from the fissure veins of the C'oeur D'Alene district in the northern part of the State. Colorado is third, with nearly 4,500,000, its source being the lead deposits of Leadville and Aspen. Arizona contributed over 500,000 ounces, which represent a great increase over 1903 and are largely derived from ores from Cochise and Pima counties. Montana and Nevada failed to reach the half million mark, counted by ounces. In both States the mining of silver-lead ores has declined in recent years. The Eureka district in Nevada, formerly a very large producer, now contributes but little.

Silver from copper ores.—About 16,000,000 ounces of silver were obtained from the smelting of copper ores. Of this, by far the largest quantity came from the Butte, Mont., copper ores, in which the silver really is a by-product, but which, nevertheless, yielded 10,236,119 ounces. On the other hand, Arizona, although a great copper producer, yielded only about 1,500,000 ounces of silver from copper ores, and much of this amount was derived from the United Verde mine. Michigan, which ranks after Montana as a copper-producing State, only yields an insignificant amount of silver. Utah follows Montana, with 2,572,582 ounces from smelting of Bingham and Tintic copper ores. None of the other States attains 1,000,000 ounces from this source, although California approaches it with 844,265 ounces, chiefly from Shasta County. As, however, much auriferous quartz is used as flux by one of the smelters, this figure is doubtless somewhat too high. Colorado is credited with only 131,695 ounces, but this hardly expresses the exact facts, for both Leadville and San Juan County yield large quantities of silver from complex lead-copper ores.

Silver from zinc ores.—Colorado is the only State which thus far has derived any silver from the smelting of zinc ores proper in which the value of the zinc exceeds that of the lead. Most of this ore is mined at Leadville, but Clear Creek and Summit counties add their quota. Smaller quantities are obtained from Gilpin, Hinsdale, Park, and Pitkin counties.

The mining of silver-bearing zinc ores will be attempted in 1905 in certain of the Butte mines in Montana. Although a large quantity of zinc is produced in the Magdalena district, New Mexico, these oxidized ores contain practically no silver.

A total of 2,004,918 ounces is derived from zinc or zinc-lead ores.

Source of silver in 1904 in Western States and Territories, by States.

[Fine ounces.]

State.	Placers.	Dry and siliceous ores.	Lead ores.	Copper ores.	Zinc ores and zinc-lead ore.
Alaska [a]	35,088	158,607			
Arizona		283,878	566,331	1,464,731	
California	2,493	584,498	49,333	844,265	
Colorado	30	7,383,097	4,427,895	131,695	2,004,918
Idaho	7,622	867,443	6,589,474	201,843	
Michigan				122,807	
Montana	327	2,116,403	464,436	10,236,119	
Nevada		3,926,465	339,139	2,519	
New Mexico		75,684	59,500	79,369	
Oregon	96	120,304		11,677	
South Dakota		159,525	1,297	789	
Texas		385,576			
Utah		158,364	9,318,500	2,572,582	
Washington		91,718	49,170	16,710	
Wyoming		46		4,601	
Southern Appalachian States [a]	300	4,000		78,600	
Total	45,956	16,315,608	21,865,075	15,768,307	2,004,918

[a] Estimated.

GOLD AND SILVER IN 1904, BY INDIVIDUAL STATES AND TERRITORIES.

ALASKA.

By CHARLES G. YALE.

PRODUCTION.

The United States Geological Survey made no attempt to gather for 1904 any details of the distribution of the precious-metal production of Alaska, and relies upon the Bureau of the Mint for the figures of total output. By distribution in this connection is meant ascertaining the source of the gold and silver by districts or sections, as in the case of counties in the several States. With Alaska this is an exceedingly difficult problem. Aside from the quartz mines of Douglas and Unga islands, and of the mainland of southeastern Alaska, the entire product is practically from surface placers. These placers exist at many points in Alaska. In practically all the placer-mining districts the short summer is the only time active work may be carried on, everything being frozen up during the winter. As a result of these conditions large numbers of the miners go "outside" for the winter, returning only in time to prepare for the water season, and again leaving when that is over. Obtaining exact data of individual output by means of correspondence under these circumstances is practically impossible.

Although there are numerous organized companies, most of the placer work is carried on upon a partnership basis or by individuals who employ labor. The clean-ups are made in the fall, and shortly afterward many miners leave their claims and can not well be reached by mail, having no permanent address.

The large quartz-mining operations in southeastern Alaska and the islands are conducted by organized companies having permanent headquarters in San Francisco or elsewhere, so that the output of such mines for the calendar year may be readily ascertained.

The placer output of Nome district, including the Golofnin Bay and the adjoining regions on the Seward Peninsula, is kept track of separately in the receipts of the United States mints and assay offices and private refineries throughout the United States; but the receipts from all other placer regions in Alaska are classed under the heading of "Alaska." While, therefore, the quartz yield and the placer yield of the Nome and adjacent districts may be segregated from the total output, the yield of all other sections is simply credited to the district of Alaska as a whole, no attempt being made to ascertain with exactness how much gold comes from Tanana, or Rampart, or Eagle Creek, or Koyukuk, or other separate districts where more or less work is carried on. The custom has been, therefore, to ascertain the yield of quartz and of Nome placers, and to credit the remainder of the total yield to balance of Alaska without attempting to apportion or distribute it with relation to source by district. To do otherwise, under the present system of conducting the inquiry as to annual product, would be practically mere guesswork.

The statement prepared at the United States mint at San Francisco, and forwarded to the Director of the Mint, showing receipts of Alaska bullion at the United States mints and assay offices and private refineries and smelters for the year 1904, places the total gold product at \$9,160,458 and the silver at \$110,405 in value. The number of fine ounces of gold is 443,177 and of silver 193,695. In the preceding year, according to the same authority, the yield of gold amounted to \$8,683,565 and of the silver to \$114,454. This shows an increase in gold output for 1904 over 1903 of \$476,893, and a decrease in silver yield of \$4,049, the total increase for the year being \$472,846.

As far as may be ascertained by the method already described as to the distribution or apportionment of production, Nome and adjoining districts on the Seward Peninsula had a total yield in 1904 of \$4,064,604 in gold and \$12,440 in silver, a falling off of nearly \$400,000 from the record of 1903. Excluding Nome, it is found that the rest of Alaska produced \$5,095,854 in gold and \$97,965 in silver. The large quartz mines in southeastern Alaska and the islands had a yield of gold of \$3,050,977 and of silver of \$9,233, which is included in the \$5,095,854 in gold and \$97,965 in silver from the rest of Alaska already mentioned. The gold and silver from the quartz mines was derived from 1,303,408 short tons of ore crushed, including 25,633 tons of sulphurets. The largest one of the quartz mines, with a product of $1,973,064 for the year, obtained $960,976 from milling 833,844 tons of ore, and $1,012,088 from 17,128 tons of concentrates shipped to smelter. The greatest values were, therefore, in the sulphurets. In these larger quartz mines there is obtained only about $3,000 worth of silver for each million dollars in gold.

The increase in value of product of the quartz mines of Alaska in 1904 over 1903 amounted to $334,387, out of a total increase of $472,846 for the district.

Deducting the gold and silver of the quartz mines, amounting to $3,050,977 in gold and $9,233 in silver, from the yield of the rest of Alaska, excluding Nome, there remain $2,044,877 in gold and $88,732 in silver for all the camps except the Nome districts and the large quartz mines. A statement of distribution would be approximately, therefore, as follows:

Distribution of gold and silver production of Alaska in 1904, by districts.

	Gold.	Silver.	Total.
Nome	$4,064,604	$12,440	$4,077,044
Quartz mines	3,050,977	9,233	3,060,210
Balance of Alaska	2,044,877	88,732	2,133,609
Total	9,160,458	110,405	9,270,863

ARIZONA.

By V. C. Heikes.

PRODUCTION.

The production of gold and silver in Arizona during the year 1904 was, gold, 168,274 ounces, of the value of $3,478,532; silver, 2,314,940 ounces, of the commercial value of $1,325,303. The statement of production compared with last year is as follows:

Production of gold and silver in Arizona in 1903 and 1904.

[Fine ounces.]

Metal.	1903.		1904.		Increase in value.
	Quantity.	Value.	Quantity.	Value.	
Gold	132,067	$2,729,824	168,274	$3,478,532	$748,708
Silver	2,109,456	[a]1,126,661	2,314,940	[b]1,325,303	198,642
Total value	....	3,856,485	....	4,803,835	947,350

[a] 1903, average commercial price of silver, 53.41 cents.
[b] 1904, average commercial price of silver, 57.25 cents.

The gold product shows an increase of 36,207 ounces, valued at $748,708; the silver product increased 205,484 ounces, which with the increase in market value represent $198,642, making a total increase of $947,350. The increase in gold product may be attributed chiefly to the increased output of copper ores and lead ores in Cochise County, credited to the Warren and Tombstone mining districts, and also to the increased yield in gold and silver bullion from the mines of Yavapai and Mohave counties. Arizona can show for the year 1904 a very satisfactory increase in the output of other metals, returns for which, along with the gold and silver, were made by the producers in the Territory to the Director of the United States Geological Survey in answer to interrogatories. The totals are given below, compared for 1903 and 1904.

Production of metals in Arizona, 1903–1904, by kinds.

Metal.	1903.		1904.		Increase.
	Quantity.	Value.	Quantity.	Value.	
Gold.......ounces..	132,067	$2,729,824	168,274	$3,478,532	$748,708
Silver.......do....	2,109,456	1,126,661	2,314,940	1,325,303	198,642
Copper.......pounds..	148,245,973	20,457,944	199,481,044	24,935,131	4,477,187
Lead.......do....	1,682,226	71,999	1,779,967	77,874	5,875
Other metals	....	1,058	....	1,455	397
Total value.......	....	24,387,486	....	29,818,295	5,430,809

The gold in this table is figured at its coining value, the other metals at the average commercial prices paid for each during the years 1903 and 1904, as follows: Gold, $20.6718 per ounce for each year; silver (1903), 53.41 cents (1904), 57.25 cents; copper (1903), 13.80 cents (1904), 12.50 cents; lead (1903), 4.28 cents (1904), 4.375 cents per pound. The total output of the Territory increased in value in 1904 by the sum of $5,430,809. The mines producing and contributing to the total output for 1904 numbered 104. In 1903 there were 117 mines reporting production, a decrease of 13 for 1904. The following table has been prepared to show the production by quantities of gold, silver, copper, and lead credited to the counties in Arizona in 1903 and 1904:

Production of metals in Arizona, 1903 and 1904, by counties.

County.	Gold.		Silver.		Copper.		Lead.	
	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Cochise	18,283	18,839	1,406,315	1,152,466	63,264,488	90,850,611	87,373	799,912
Coconino and Maricopa	58	199	3,908	1,780	257,022	333,754	....	....
Gila	72	166	1,357	9,671	7,740,843	14,677,561	....	....
Graham	443	2,217	13,644	43,963	52,839,856	59,537,295	....	....
Mohave	15,859	27,275	54,169	86,782	31,931	1,480	377,608	6,036
Pima	473	493	2,450	43,052	15,000	3,039,219	5,500	177,475
Pinal	238	212	3,461	4,482	84,000	186,638	2,500	3,334
Santa Cruz	540	....	4,080	5,265	4,162	27,000	66,884	37,855
Yavapai	77,843	97,415	602,087	953,622	23,999,628	30,826,286	841,404	497,905
Yuma	18,258	21,458	17,985	13,857	9,043	1,200	300,957	257,450
Total	132,067	168,274	2,109,456	2,314,940	148,245,973	199,481,044	1,682,226	1,779,967

In the following table the tons of ore sold or treated and the number of mines producing in Arizona are given for 1903 and 1904, by counties:

Number of tons of ore sold or treated, the number of mines producing, and total value of gold and silver contents for 1903 and 1904, by counties.

County.	Total tons of ore sold or treated.		Number of mines producing.		Total and average value gold and silver contents.			
					1903.		1904.	
	1903.	1904.	1903.	1904.	Total value.	Value per ton.	Total value.	Value per ton.
Cochise	404,897	686,767	20	14	$1,129,023	$2.79	$1,049,224	[a] $1.53
Coconino and Maricopa	626	1,453	3	3	3,286	5.25	6,350	4.37
Gila	64,335	100,101	9	11	2,213	.03	7,751	[a] .08
Graham	795,794	958,019	10	7	16,444	.02	70,998	[a] .07
Mohave	31,212	47,520	19	13	356,737	11.43	613,507	12.91
Pima	804	1,868	7	7	11,086	13.79	34,838	18.64
Pinal	853	965	6	5	6,768	7.93	6,949	7.20
Santa Cruz	1,976	461	5	3	13,341	6.75	3,014	6.54
Yavapai	301,770	439,622	31	34	1,930,589	6.39	2,559,695	5.82
Yuma	61,215	69,162	7	7	386,998	6.32	451,509	6.53
Total	1,663,482	2,305,938	117	104	3,856,485	2.32	4,803,835	2.08

[a] Low figures due to large quantity of copper ores of low gold and silver value.

The following table shows the distribution of the total gold production of the Territory. The products for 1903 and 1904 were as follows:

Production of gold in Arizona in 1903 and 1904, by counties.

[Fine ounces.]

County.	1903.		1904.		Increase (+) or decrease (−) in quantity.
	Quantity.	Value.	Quantity.	Value.	
Cochise	18,283	$377,910	18,839	$389,437	+ 556
Coconino, Gila, and Maricopa	130	2,687	365	7,545	+ 235
Graham	443	9,157	2,217	45,829	+ 1,774
Mohave	15,859	327,806	27,275	563,824	+11,416
Pima	473	9,777	493	10,191	+ 20
Pinal	238	4,919	212	4,383	− 26
Santa Cruz	540	11,162			− 540
Yavapai	77,843	1,609,014	97,415	2,013,747	+19,572
Yuma	18,258	377,392	21,458	443,576	+ 3,200
Total	132,067	2,729,824	168,274	3,478,532	+36,207

The output of gold from Arizona originates in Yavapai, Mohave, Yuma, and Cochise counties, named in the order of importance. The increase shown for Yavapai County is explained by the more active operations and extractions of ore from several of the largest properties, notably the United Verde, in Verde district; the Congress mines, in Martinez district; and the Ideal Mining and Milling Company, the Model Mining Company, the Bradshaw Mountain Copper Mining and Smelting Company, the American Copper Company, and the Braganza Gold Mining Company, in the Big Bug mining district.

In Mohave County the output of gold was increased mainly by the Gold Roads mine, located in the San Francisco district; in Yuma County; the King of Arizona, of the Kofa district; and in Cochise County, mainly in the copper ores of the Warren district and the argentiferous lead ores of the Tombstone district.

The distribution of the aggregate quantity of the gold output for 1903 and 1904 into the several classes of ores gives the results shown in the following table:

Production of gold in Arizona for 1903 and 1904, by kinds of ore.

[Fine ounces.]

Year.	Placer.	Siliceous ores.	Ores cyanided.	Lead ores.	Copper ores.	Total.
1903	568	22,404	79,639	3,600	25,856	132,067
1904	815	39,188	68,023	12,685	47,563	168,274

The gold taken from the placers in Arizona came principally from Greaterville and Quijotoa districts, in Pima County. The other regions contributing were Dos Cabezas, in Cochise County; Old Hat district, in Pinal County, and the Plomosa district, in Yuma County, making up the total. There are extensive deposits of auriferous gravel, upon which large operations are contemplated, at Greaterville.

Gold from siliceous ores increased largely in Yavapai and Mohave counties. The gold extracted by cyanide decreased principally in Yavapai and Cochise counties, but this decrease was nearly made up by the output of this class of gold in Mohave County.

The gold taken from lead ores in 1904 shows a large increase over the preceding year, which was occasioned by the increased tonnage of this class of ore mined in Tombstone district, of Cochise County, and of the output of lead ores in Yavapai County.

The gold recovered in connection with the mining of copper ores shows an increase for the year principally on account of increased output of this class of ores in Cochise and Yavapai counties.

The following table shows the output of silver in Arizona for the years 1903 and 1904, with the increase and decrease, by counties:

Silver production in Arizona in 1903 and 1904, by counties.

[Fine ounces.]

County.	1903.		1904.		
	Quantity.	Value.	Quantity.	Value.	Increase (+) or decrease (−) in quantity
Cochise	1,406,315	$751,113	1,152,466	$659,787	−253,849
Coconino, Gila, and Maricopa	5,265	2,812	11,451	6,556	+ 6,186
Graham	13,644	7,287	43,963	25,169	+ 30,319
Mohave	54,169	28,931	86,782	49,683	+ 32,613
Pima	2,450	1,309	43,052	24,647	+ 40,602
Pinal	3,461	1,849	4,482	2,566	+ 1,021
Santa Cruz	4,080	2,179	5,265	3,014	+ 1,185
Yavapai	602,087	321,575	953,622	545,948	+351,535
Yuma	17,985	9,606	13,857	7,933	− 4,128
Total	2,109,456	1,126,661	2,314,940	1,325,303	+205,484

Production of silver in Arizona in 1903 and 1904, by kinds of ore.

[Fine ounces.]

Year.	Placers.	Siliceous ores.	Ores cyanided.	Lead ores.	Copper ores.	Total.
1903	20	1,068,317	50,158	84,757	906,204	2,109,456
1904	0	181,177	102,701	566,331	1,464,731	2,314,940

Silver was not reported by the placer operators in 1904 and is left out of the total entirely, not being of sufficient importance even to estimate. The decrease shown in siliceous ores occurred chiefly in Cochise County. The ores cyanided increased the yield of silver from certain mines in Mohave County. The lead ores of Cochise and Pima counties largely increased the silver yield, while from copper ores, Yavapai County has the greatest increase, with Cochise, Gila, and Pima counties following.

MINES.

In 1903 the tabulated list of producing properties numbered 183. This number has been reduced to 171, a difference of 12, which represents mining properties either combined with larger corporations or abandoned.

The tabulated list for 1904 shows 171 properties known as producers of mineral in distinction to mere prospects, but only 104 reported production in 1904. All mines idle for several years are excluded from this list. The 104 mines producing in 1904, classified according to their main product, are contrasted in the following table with the 117 mines producing in 1903.

Producing mines in Arizona in 1903 and 1904, classified by chief product.

Year.	Mines reporting production.	Gold mines	Silver mines.	Copper mines.	Lead mines.
1903	117	55	17	38	7
1904	104	47	17	35	5
Decrease	13	8	0	3	2

The number of mines in which the value of gold, silver, copper, and lead predominated in 1904, by counties, is as follows:

The gold value exceeded the value of other metals in Yavapai County in 24 properties; in Mohave, in 9; Yuma, 5; Cochise, 3; Pima, 2; Pinal, 2; Gila, 1—total, 47; a decrease of 8 for 1904.

The silver value exceeded the value of other metals, by counties, as follows: Cochise and Mohave counties are each credited with 4 mines, and Yavapai, Santa Cruz, Graham, and Gila counties each have 1—a total of 17, which is the same number that reported in 1903.

Classified according to the copper product, Gila County is credited with 9 properties, Yavapai with 8, Cochise and Graham each with 5, Pima with 3, Pinal with 2, Coconino, Maricopa, and Santa Cruz each with 1—total 35; a decrease of 3 for 1904. Compared according to the values of the copper product for 1904, Cochise County leads, with Graham, Yavapai, Gila, and Pima following.

Of the 5 lead properties 2 are credited to Cochise County, 2 to Yuma County, and 1 to Pinal County.

The reports returned from mine operations in Arizona numbered 748. Of this number 639 lode mines and 5 placers reported development and assessment work; the remainder, 104, were producing properties. Ninety-seven of these were quartz or lode mines and seven were placer mines. In addition, 85 milling and 15 smelting plants were reported. Of the milling plants connected with mines, 33, including 2 arrastras, were in operation, and 52 mills, including 4 arrastras, were idle.

Of the 15 smelters in the Territory, 8 were operating copper plants and 1 a lead plant; 6 were idle, and 2 were in course of completion. One of the latter was expected to handle lead-silver ores besides the copper ores for which the plant was already equipped.

Of the 33 milling establishments, 27 used stamps for crushing the ores, and 6 used crushers and rolls of various patterns. Eleven of the 33 mills used amalgamation followed by concentration; 7 used direct amalgamation with batteries and plates; 6 used amalgamation followed by treating the tailings with cyanide; 5 were concentration plants; and 4 used direct treatment of the crushed ores by cyanide.

ORES SMELTED.

In a number of instances the mine operators in Arizona reported the total number of ounces or pounds of metal produced for the year. When the report was thus made, the average commercial price was used in extending the value. When only values were given, if consistent, they were allowed to remain. The total values, therefore, for the Territory should show in a measure the amounts paid for the metals, less smelting and refining charges. The total tonnage of ore smelted and milled, of concentrates produced, and old tailings treated by cyanide, with the total values summed up from the returns sent in by producers, are as follows:

Ores sold or treated in Arizona in 1904.

[Short tons.]

	Quantity.	Value.
Ores shipped to smelters	1,211,440	$22,259,152
Ores milled	1,021,538	1,625,359
Concentrated ores	119,654	5,302,411
Old tailings treated by cyanide	74,747	164,373
Total		29,351,295

It is found by the figures of the mine operators in Arizona for 1904 that for ores sold and treated gold averaged $19.90 per ounce; silver, 56.58 cents per ounce; copper, 12.34 cents per pound; lead, 3.59 cents per pound. Ores shipped and treated at smelters during 1904 from Arizona properties amounted to 1,211,440 short tons, on which was realized $22,259,152 for the gold, silver, copper, and lead contents of the ores, or an average value per ton of $18.37.

The largest portion of the ore mined in Arizona is treated at reduction works connected with mines. This accounts for the low value per ton of the ores smelted. The ores shipped out of the Territory contained a greater value. The total quantity of ore milled was 1,021,538 tons. All the ore concentrated was so treated at plants belonging to the mines. The quantity of concentrates produced was 119,654 tons; the average degree of concentration was accordingly 1 ton of concentrates to about 9 tons of crude ore. This reduces the ore to be shipped to one-ninth of its original weight. A large saving is thus effected in freight and treatment charges. From the 119,654 tons of concentrates $5,302,411 was realized for the gold, silver, copper, and lead contents, or an average of $44.31 per ton. In addition, gold and silver bullion produced by amalgamation and cyaniding and shipped to the refineries amounted to $1,625,359, an average value of $1.59 per ton. From 74,747 tons of old tailings $164,373 was realized from bullion and cyanide product, an average of $2.20 per ton of tailings.

Arizona has 13 counties. Eleven of these reported production of gold, silver, copper, and lead in 1904. There are 211 mining districts in the Territory. Mine operators reported from 53 of these districts, giving the total output of ore sold or treated in 1904.

ARIZONA METAL PRODUCERS.

In the following table the number of properties in Arizona reporting production to the United States Geological Survey is noted for 1903 and 1904, with the number of mines producing during both years; also the number of properties not producers in 1903, but which produced in 1904, and vice versa, with the total number of producers in the Territory heard from for the last two years, is given by counties:

Metal-producing mines in Arizona in 1903 and 1904, by counties.

County.	Producing properties in Arizona, by counties, in—		Productive mines in 1903 producing a gain in 1904.	New producers in 1904.	Properties productive in 1903 but reporting nothing in 1904.	Total number of properties which have been producers in the last two years, 1903 and 1904.
	1903.	1904.				
Cochise	20	14	7	7	15	29
Coconino	2	1	1	0	1	2
Gila	9	11	6	5	3	14
Graham	10	7	5	2	5	12
Maricopa	1	2	0	2	1	3
Mohave	19	13	7	6	12	25
Pima	7	7	1	6	6	13
Pinal	6	5	3	2	3	8
Santa Cruz	5	3	3	0	2	5
Yavapai	31	34	14	20	17	51
Yuma	7	7	5	2	2	9
Total	117	104	52	52	67	171

CALIFORNIA.

By Charles G. Yale.

PRODUCTION.

Direct returns received by the United States Geological Survey from mining companies and individual producers for the calendar year 1904 show that the State of California had a gold yield of the value of $18,633,676; silver, $843,936 (commercial value, at 57 cents per ounce); copper, $3,786,022; lead, $4,070, and platinum, $1,866—a total of $23,269,570. Comparing these figures with corresponding ones for the preceding year, it is shown that the gold output of the State has increased $2,333,023; silver, $345,524; copper, $1,252,667; lead, decrease, $3,004; platinum, increase, $914. The total increase in yield for these metals in 1904 over 1903 is, therefore, for the State, $3,929,124.

Production of gold, silver, copper, lead, and platinum in California in 1904, by counties.

County.	Gold.		Silver.		Copper.	
	Placer.	Quartz.	Placer.	Quartz.	Quantity.	Value.
					Pounds.	
Alpine		$4,827		$145		
Amador	$26,112	2,054,689		6,575	14,000	$1,400
Butte	1,909,270	37,315	$1,112	1,134		
Calaveras	255,448	1,531,588		69,519	2,611,660	277,165
Del Norte	7,317					
Eldorado	90,958	285,751		16		
Fresno	3,117	4,595		4		
Humboldt	61,058	93				
Inyo		135,788		38,868	8,408	850
Kern	3,230	1,381,511		157,620		
Lassen		115,993		1,514		
Los Angeles	50	12,351		73		
Madera	100	75,103		25	10,300	1,300
Mariposa	3,304	424,749		2,801	9,500	1,140
Mono		266,286		10,330		
Monterey	7,168	500				
Mendocino	37					
Nevada	310,270	2,620,844	161	12,185		
Placer	589,039	201,302	9	12,036	600,000	72,000
Plumas	97,640	161,087	10	454		
Riverside		7,419		73		
Sacramento	410,718					
San Bernardino	8,600	589,124		13,571	154,477	15,020
San Diego	6,000	326,685		212		
San Luis Obispo	630					
Shasta	21,082	1,011,085		399,686	26,438,145	3,402,517
Sierra	221,428	158,694		1,547		
Siskiyou	454,295	348,301	31	1,113		
Stanislaus		50,000		265	7,300	930
Trinity	349,672	189,441	69	80		
Tulare		1,100				
Tuolumne	13,085	1,643,461		12,669		

Production of gold, silver, copper, lead, and platinum in California in 1904, by counties—Con.

County.	Gold.		Silver.		Copper	
	Placer.	Quartz.	Placer.	Quartz.	Quantity.	Value.
					Pounds.	
Ventura	$200	$3,500				
Yuba	135,462	5,204	$29			
Unapportioned				$100,000	107,800	$13,700
Total	4,985,290	13,648,386	1,421	842,515	29,961,590	3,786,022
Grand total		18,633,676		843,936		3,786,022

County.	Lead.		Platinum.	Total value.
	Quantity.	Value.		
	Pounds.			
Alpine				$4,972
Amador				2,088,776
Butte			$1,045	1,949,876
Calaveras				2,133,720
Del Norte			20	7,337
Eldorado				376,725
Fresno				7,716
Humboldt			150	61,301
Inyo	124,200	$4,070		179,576
Kern				1,542,361
Lassen				117,507
Los Angeles				12,474
Madera				76,528
Mariposa				431,994
Mono				276,616
Monterey				7,668
Mendocino				37
Nevada				2,943,460
Placer			365	874,751
Plumas				259,191
Riverside				7,492
Sacramento				410,718
San Bernardino				626,315
San Diego				332,897
San Luis Obispo				630
Shasta				4,834,370
Sierra				381,669
Siskiyou			16	803,756
Stanislaus				51,195
Trinity			270	539,532
Tulare				1,100
Tuolumne				1,669,215
Ventura				3,700
Yuba				140,695
Unapportioned				113,700
Total	124,200	4,070	1,866	23,269,570
Grand total		4,070	1,866	23,269,570

As stated, these conclusions are based on direct returns from the producers in answer to inquiries made by the United States Geological

Survey. It is proper to state that in the matter of gold, particularly, the actual value of output is doubtless over rather than under the figures presented. This is due to the fact that there are many hundreds of foreign miners, such as Chinese, Portuguese, Italians, etc., who are working on a small scale in gravel mines, and some few in quartz, from whom it is impossible to obtain returns. They are nomadic to a certain extent, working in bars, river beds, gulches, etc., during the water season and then leaving the locality until the next year. While most of them individually obtain comparatively small amounts for their season's work, the sums in the aggregate amount to many thousands of dollars. It is practically impossible to obtain direct returns from this class of miners, many of whom do not understand the language, and few of whom reply to inquiries as to what they obtain from their claims.

It is for this reason, doubtless, that the figures of gold yield obtained by the Director of the United States Mint on the basis of total annual receipts of metal received at United States mints and assay offices and private refineries are apt to exceed the figures obtained by the United States Geological Survey when based only on direct returns from producers. But in taking only mint, assay office, and refinery returns, it is impossible to obtain any data as to distribution by counties in any State, as those offices keep no such close record. Neither is it possible on such a basis to ascertain exact source of the gold, as from quartz, hydraulic, drift, dredging, copper or lead ores, etc.

Accurately exact results, therefore, when based on direct returns only, are not expected so much as close approximations in figuring out the totals of State production for the year. Without these direct returns, however, as stated, it is impossible to learn either distribution or source of the metals, or to tell which branch of the industry is progressing or which retrograding. For example, tables are given in this chapter which show the source of each of the metals by county, how much of each metal came from each county, and also by its increased output how each branch of mining has progressed, by comparison with corresponding tables of the preceding year.

By these means it is ascertained that the quartz mines produced $1,400,494 more in 1904 than in 1903; the hydraulic mines, $155,371; the drift mines, $28,275; the dredges, $711,289, and the surface placers, $37,594 more—the total increase being $2,333,023. This, then, shows that the hydraulic, drift, dredging, and placer mines combined increased their yield $931,529, and also that the yield of the quartz mines alone exceeded that combined yield by $468,965. The largest source of gross increased gold product is therefore from quartz mining operations and not from the gravels, and particularly not from dredge mining, as is popularly supposed. In percentage of increase in proportion to the number of properties operated, however, the dredging industry leads. The yield from that source now exceeds the combined yield of the hydraulic and drift mines of the State by $225,901, and exceeds the surface placer yield by $1,350,923. The probability is that in 1905 the yield of the dredges will exceed that of the surface placers, drift, and hydraulic mines combined. Of course dredging is only an improved form of placer mining where modern mechanical appliances are put in use to handle large quantities of material in a short time by steam or electric power, the gold-saving apparatus of sluices and riffles with quicksilver being little different in character from what they have been for many years in placer-mining work.

METHODS OF MINING.

Dredge mining.—As much interest in the gold dredging industry of California is manifested outside of the State, it is proper to note that it continues to show a very marked increase in output from year to year, and is generally considered to be the most rapidly advancing branch of gold mining in California. As far as gross results in dollars and cents are concerned, however, the figures do not bear out this conclusion, the quartz mines continuing, as stated, to lead in total output and also in amount of increase in yield from year to year. It is true that the quartz properties largely outnumber the dredges and are productive in 30 out of the 57 counties in the State, while dredges are only being operated in 6 counties. In 1903 the dredges produced $1,475,749, as compared with $867,665 in 1902, an increase of $608,084. In 1904 they produced $2,187,038, as compared with $1,475,749 in 1903, an increase of $711,289. Quartz mines produced $12,247,892 in 1903 and $13,648,386 in 1904, so the increase of $1,400,494 in quartz for one year is slightly above the total increase of dredges in two years combined.

The dredging increase of output would doubtless have been more marked had all the machines which were operated in 1904 been at work throughout the year. The fact is, however, several machines of the largest and most modern type were not completed and set in operation until the last two or three months of 1904.

At the end of 1904 there were in the Oroville district, Butte County, 28 dredges at work; in Sacramento County, Folsom district, 5; Siskiyou County, 1; Trinity County, 1; Yuba County, 2; Shasta County, 2, and Calaveras County, 1, a total of 40 machines in operation, some of them, however, for only part of the year. Considering them all to have been in operation throughout the year, the average gross yield per dredge would be a little above $54,675. The ground naturally varies in value per cubic yard in different districts and in different areas in the same district, and the machines vary in size and capacity. Some dredges, therefore, run above this average, but others, again, run below it. Taking the whole 40 machines, however, the average output of gold for each is as stated.

Hydraulic mining.—In hydraulic mining the increase of output is only $155,371 over that of 1903, yet that may be considered a satisfactory showing in view of the conditions surrounding that branch of gold mining in recent years. In the vast area of mountains and foothills embracing the drainage basins of the Sacramento and the San Joaquin rivers, where the largest tracts of auriferous gravel are situated, the Federal laws impose certain restrictions which materially curtail the quantity of gravel possible to hydraulic, and therefore reduce the annual yield far below the possibilities were men free to work as in former years.

The leading hydraulic mining county is now Trinity, with a record in 1904 of $269,921 of gold from that source, followed by Siskiyou with $243,947; Placer, with $119,500; and Nevada, with $106,730. Other counties yielding less than a hundred thousand dollars are, in their order of output, Butte, Calaveras, Sierra, Humboldt, Plumas, El Dorado, Yuba, Tuolumne, Del Norte, and Amador; minor amounts come from a few other counties.

Drift mining.—The drift mines of the State show only the slight increase of $28,275 over the output of 1903. It can not be said that this industry is progressing as rapidly as might be expected in view of the large Neocene deposits of auriferous gravel lying undeveloped on the channels of the "dead rivers" under the lava-capped divides.

The most important center of the drift-mining industry of the State continues in Placer County, mainly on the Forest Hill and Iowa Hill divides. The county produced in 1904 the sum of $347,019 from that source, an increase of about $10,000. Nevada County comes next with $173,001, and is followed in order by Sierra with $139,937; Butte, $121,983; Calaveras, $42,976; Sacramento, $41,928; El Dorado, $33,481; and Amador, Kern, Mariposa, Shasta, Siskiyou, Trinity, Tuolumne, and Yuba with smaller amounts.

Surface placer mining.—The so-called surface placers of the State are credited in the statistical tables in this chapter with an output in 1904 of $836,115, an increase of $37,594 over 1903. These placers include river bed and bar mining, ground sluicing, ocean beach-sand mines, gulch and ordinary surface gravel claims—in fact all forms of gravel mining except hydraulic, drift, and dredge.

The tabulated statement in this section (p. 63) shows that the highest yield from surface placers comes from Siskiyou County, which produced $192,196 from this source in 1904; Placer County follows with $122,520 and Butte with $87,079; Trinity County returns $70,626; Plumas, $67,649; Yuba, $43,148; Eldorado, $39,251; Sierra, $34,840; and Calaveras, $31,419; the other counties return smaller amounts. Considerable placer work continues to be done in a small way by men who work in the fields in the harvest season in the valley and foothill counties, and then take to placer mining during the water season.

Quartz mining.—Notwithstanding the steady and gratifying annual increase of gold from the gravels quartz mining continues to be the leading gold-producing branch of the industry in California. Out of a total gold product of $18,633,676 in 1904, the sum of $13,648,386 came from the quartz mines, which is an increase of $1,400,494 from that source, over the previous year. The total gold increase from the gravels was, as previously stated, $932,529, so that the quartz mines show an increase of $468,965 more than that of all classes of gravel mining, drift, hydraulic, dredge, and surface placers. And yet there are 711 producing gravel mines of all classes as compared with 474 producing quartz mines, large and small, in the State, or 237 more placer than quartz mines in a productive stage. From a fully developed and equipped quartz mine, however, there is usually a larger annual production than from a gravel mine worked under similar conditions.

The inquiries pursued by the United States Geological Survey show that there were in California 474 producing quartz mines in 1904 and 1,278 on which development work or annual labor was being performed, making 1,752 active quartz properties in addition to the large number of idle ones. From the returns it is found that the largest number of producing quartz mines is in Kern County—44 in all—but it does not follow that these are the largest producers; Nevada County has 41; Tuolumne, 38; Shasta, 35; Siskiyou, 34; Calaveras, 32; Eldorado, 31; Inyo and Trinity each, 27; Amador, 23; and Placer, 21. All the other counties have less than 20. As to mines in the development stage or held by annual labor without production, the largest numbers are in Calaveras and Shasta counties, each of them having 110; Siskiyou has 85; Kern and Tuolumne each, 80; Eldorado follows with 78; Nevada with 76; Inyo, Plumas, and Trinity each have 50. The other counties have smaller numbers, but all of the 30 quartz gold-producing counties have more or less.

There are now 6 counties of the State in which the quartz mines are producing over $1,000,000 a year, and in 2 of these the output is over $2,000,000. The leading county in this respect is Nevada, which is also the largest gold producer, a position which it has held for many consecutive years. Out of a total of $2,931,114 of gold in that county in 1904, the sum of $2,620,844 was derived from quartz-mining operations. Amador, next in rank, has to the credit of its quartz mines $2,054,689 in 1904. Tuolumne follows with $1,643,461 from this source, and Calaveras with $1,011,085. Amador, Calaveras, and Tuolumne are recognized as "mother-lode counties," but the others are not. The five mother-lode counties produced from their quartz last year $5,940,238, and a total amount of gold from all sources of $6,329,151, as compared with $13,648,386 for the whole State from quartz and $18,633,676 for the whole State from all sources of gold mining.

Ore treated, and value of gold, silver, copper, and lead recovered in 1904, by counties.

[Short tons.]

County.	Ore milled.		Ore smelted.	
	Quantity.	Value.	Quantity.	Value.
Alpine	900	$4,972		
Amador	526,071	2,015,661		
Butte	11,166	38,449		
Calaveras	604,741	1,291,780	30,836	$580,992
Eldorado	56,103	285,767		
Fresno	25	4,599		
Humboldt	29	93		
Inyo	9,448	133,099	650	35,487
Kern	213,645	1,452,963	4,008	79,163
Lassen	15,000	117,307		
Los Angeles	4,171	12,424		
Madera	7,249	75,128		
Mariposa	92,169	427,490	20	1,200
Monterey	25	500		
Mono	22,384	269,105		
Nevada	255,729	2,449,648	2,291	183,381
Placer	41,076	187,788	10,007	97,550
Plumas	29,816	160,385	14	156
Riverside	380	6,251	41	1,241
San Bernardino	32,802	523,258	1,726	83,433
San Diego	47,680	194,171	6	626
Shasta	35,979	546,995	269,021	4,266,293
Sierra	30,348	151,496	39	8,745
Siskiyou	26,690	348,676	16	738
Stanislaus	14,000	50,265		
Trinity	25,228	188,521	100	1,000
Tulare	10	1,100		
Tuolumne	357,374	1,532,829	3,040	92,843
Ventura	120	3,500		
Yuba	265	5,204		
Total	2,460.623	12,479.424	321.815	5,432.853

Average value per ton: Ore milled, $5.07; ore smelted, $16.88.

In the preceding table the averages of the smelting ores are also given. Inyo has both lead and silver to its credit. In all the other counties the copper ores are considered, and also the gold and silver derived from the smelting of these ores. The most extensive operations are shown to be in Shasta County. It has been found somewhat difficult to get at exact data concerning the lead ores, most of the ores shipped being small lots and from mines worked intermittently.

The following table gives the total gold derived from siliceous, copper, and lead ores, respectively, and also the silver from the same sources. These figures are, of course, for deep mines only, no placers of any kind being considered.

Value of gold and silver produced from deep mines in California in 1904, by kinds of ore and by counties.

County.	Gold.			Total value.
	Siliceous ores.	Copper ores.	Lead ores.	
Alpine	$4,827			$4,827
Amador	2,054,689			2,054,689
Butte	37,315			37,315
Calaveras	1,456,886	$74,702		1,531,588
Eldorado	285,751			285,751
Fresno	4,595			4,595
Humboldt	93			93
Inyo	135,218	50	$520	135,788
Kern	1,381,511			1,381,511
Lassen	115,993			115,993
Los Angeles	12,351			12,351
Madera	75,103			75,103
Mariposa	424,709	40		424,749
Mono	266,286			266,286
Monterey	500			500
Nevada	2,620,844			2,620,844
Placer	185,302	16,000		201,302
Plumas	161,087			161,087
Riverside	7,419			7,419
San Bernardino	538,621	50,503		589,124
San Diego	326,685			326,685
Shasta	641,272	369,813		1,011,085
Sierra	158,694			158,694
Siskiyou	348,301			348,301
Stanislaus	50,000			50,000
Trinity	189,441			189,441
Tulare	1,100			1,100
Tuolumne	1,643,461			1,643,461
Ventura	3,500			3,500
Yuba	5,204			5,204
Total	13,136,758	511,108	520	13,648,386
Fine ounces	635,547.073	24,727.044	25.157	660,299.274

Value of gold and silver produced from deep mines in California in 1904, etc.—Cont'd.

County.	Silver.			Total value.
	Siliceous ores.	Copper ores.	Lead ores.	
Alpine	$145			$145
Amador	6,575			6,575
Butte	1,134			1,134
Calaveras	5,143	$64,376		69,519
Eldorado	16			16
Fresno	4			4
Inyo	10,648	100	$28,120	38,868
Kern	157,620			157,620
Lassen	1,514			1,514
Los Angeles	73			73
Madera	25			25
Mariposa	2,781	20		2,801
Mono	10,330			10,330
Nevada	12,185			12,185
Placer	2,916	9,120		12,036
Plumas	454			454
Riverside	73			73
San Bernardino	546	13,025		13,571
San Diego	212			212
Shasta	5,096	394,590		399,686
Sierra	1,547			1,547
Siskiyou	1,113			1,113
Stanislaus	265			265
Trinity	80			80
Tuolumne	12,669			12,669
Unapportioned silver	100,000			100,000
Total	333,164	481,231	28,120	842,515
Fine ounces	584,498.25	844,264.91	49,333.33	1,478,096.49

PRODUCING AND NONPRODUCING MINES.

The table of producing and nonproducing mines in California is instructive in this respect at least, that it shows how greatly capital is needed to put development or assessment mines in the way of becoming productive ones. Of producing and active mines in California there are in all 2,650, but many hundreds more were idle during the year, mainly for lack of capital. There were 1,160 producing mines in the State in 1903, and 1,185 in 1904, an increase of 25; there were 1,426 active nonproductive mines in 1903 and 1,465 in 1904, an increase of 39—a total increase of 64 active mines for the year. The appended table shows 474 producing quartz mines, and 1,189 quartz mines being developed or held by assessment work, and 711 producing placers (including hydraulic, dredge, drift, and surface placers) and 276 placers under development. No account is taken in these figures of any mines which are merely lying idle, but from which answers have been received.

Producing and nonproducing mines in California in 1904, by counties.

County.	Producing mines.		Development or assessment mines.	
	Quartz.	Placer.	Quartz.	Placer.
Alpine	1	....	5	....
Amador	23	14	45	9
Butte	8	79	46	35
Calaveras	32	26	110	20
Del Norte	....	7	....	2
Eldorado	31	35	79	15
Fresno	5	5	16	....
Humboldt	1	21	2	4
Inyo	27	....	50	1
Kern	44	3	80	....
Lassen	1	....	8	....
Los Angeles	1	1	5	....
Madera	8	1	35	....
Mariposa	19	3	53	....
Mono	12	....	22	....
Mendocino	....	1	1	....
Monterey	1	2	4	....
Nevada	41	24	76	10
Orange	....	....	4	....
Placer	21	75	23	31
Plumas	18	96	50	47
Riverside	5	....	15	1
Sacramento	....	7	....	4
San Bernardino	13	4	36	....
San Diego	11	3	37	2
San Luis Obispo	....	2	....	1
Shasta	35	15	110	5
Sierra	10	53	40	32
Siskiyou	34	128	85	20
Stanislaus	1	....	....	....
Tehama	....	....	1	....
Trinity	27	61	50	12
Tulare	1	....	10	....
Tuolumne	38	7	80	12
Ventura	1	1	3	....
Yuba	4	37	8	13
Total	474	711	1,189	276

Rank of counties according to total number of mines in California in 1904.

County.	Producing mines.	Development mines.	Total active mines.	County.	Producing mines.	Development mines.	Total active mines.
Siskiyou	162	105	267	Mono	12	22	34
Plumas	114	97	211	Humboldt	22	6	28
Calaveras	58	130	188	Fresno	10	16	26
Butte	87	81	168	Riverside	5	16	21
Shasta	50	115	165	Sacramento	7	4	11
Eldorado	66	94	160	Tulare	1	10	11
Nevada	65	86	151	Lassen	1	8	9
Placer	96	54	150	Del Norte	7	2	9
Trinity	88	62	150	Monterey	3	4	7
Tuolomne	45	92	137	Los Angeles	2	5	7
Sierra	63	72	135	Alpine	1	5	6
Kern	47	80	127	Ventura	2	3	5
Amador	37	54	91	Orange	0	4	4
Inyo	27	51	78	San Luis Obispo	2	1	3
Mariposa	22	53	75	Mendocino	1	1	2
Yuba	41	21	62	Stanislaus	1	....	1
San Bernardino	17	36	53	Tehama	0	1	1
San Diego	14	39	53	Total	1,185	1,465	2,650
Madera	9	35	44				

Possibly in fixing the standard of mining counties, in a comparative sense, the basis should be the total output for one year rather than the mere number of active mines, and a table on this basis is given elsewhere in this section. But in addition, it is interesting to note the number of productive and development mines in each county as shown in the preceding table. As to actual producing mines, the relative standing of the more prominent counties is as follows: (1) Siskiyou, 162; (2) Plumas, 114; (3) Placer, 96; (4) Trinity, 88; (5) Butte, 87; (6) Eldorado, 66; (7) Nevada, 65; (8) Sierra, 63; (9) Calaveras, 58; (10) Shasta, 50; (11) Kern, 47; (12) Tuolomne, 45; (13) Yuba, 41; (14) Amador, 37; (15) Inyo, 27; (16) Mariposa, 22; (17) Humboldt, 22; (18) San Bernardino, 17; (19) San Diego, 14; (20) Mono, 12; (21) Fresno, 10. All the rest have less than 10 producing mines.

One of the tables in this section shows the quantity of ore crushed in each county of the State, with the values recovered. In the average of \$5.07 per ton, \$4.94 was gold and 13 cents silver. There are very wide differences, however, in the average milling values in the different counties, just as there are when different mines are compared. A few examples of average values per ton in the more prominent counties may be cited as follows:

Average value per ton of gold and silver ores in nine counties of California in 1904.

County.	Tons milled.	Average value per ton.	County.	Tons milled.	Average value per ton.
Amador	526,071	\$3.83	Kern	213,645	\$6.80
Calaveras	604,741	2.13½	Nevada	255,729	9.58
Eldorado	56,103	5.09	Shasta	35,979	15.20
Mariposa	92,169	4.64	Siskiyou	26,670	18.49
Tuolumne	357,374	4.34			

For reasons previously stated these averages may be considered as exclusive of the sulphuret values. The first five counties named are the mother-lode counties, where the veins are large and the ores generally of low grade. It may be noted that among these the county with the largest tonnage has the lowest average value, and the county with the smallest tonnage has the highest average value. In the case of Calaveras County, one very extensively operated mine, with very low grade ore, has brought the average value below what may be considered the normal. Both Kern and Nevada counties make excellent showings, both in tonnage and in average value. In Shasta and Siskiyou counties the ores worked are of high grade, but the gross quantities are comparatively small.

It should be satisfactory to the mining community of California to know that the figures collected by the United States Geological Survey show that the State increased its total output of gold, silver, lead, copper, and platinum in 1904 over that of 1903 by $3,929,124, or at the rate of $327,427 per month for the year under review. An abstract comparative statement is as follows:

Comparative production of gold, silver, copper, lead, and platinum in California in 1903 and 1904.

	1904.	1903.	Increase in 1904.
Gold	$18,633,676	300,653	$2,333,023
Silver	843,936	498,412	345,524
Copper	3,786,022	533,355	1,252,667
Lead	4,070	7,074	....
Platinum	1,866	952	914
	23,269,570	19,340,446	3,932,128
Decrease in value of lead in 1904			3,004
Total increase			3,929,124

From the tables given in this chapter it may readily be seen which of the counties of the State are the best for quartz mining and which for gravel mining, and it may also be seen which counties make the largest annual yield from the different forms of gravel mining, hydraulic, drift, dredging, and surface placer. Nevada produces more gold from quartz than any other county, Trinity more from hydraulic mines, Placer more from drift, Butte more from dredging, and Siskiyou more from surface placers.

In quartz mining the leading counties in their order of productive rank have already been noted both in text and in tables, and the same has been done for the different forms of gravel mining considered separately. As to rank, where all forms of gravel or placer mining combined are considered, Butte takes the lead, and is the only one showing over $1,000,000 yield from such sources; indeed, the amount reaches nearly $2,000,000 in that county, owing to the number of dredges at work. The next is Placer County, where there are so many profitable drift mines. Then follow Siskiyou, Sacramento, Trinity, Nevada, Calaveras, Sierra, and Yuba in the order named, only those being here mentioned which made an output of over $100,000 for the year.

Source of California gold, by counties, in 1904.

County.	Quartz mines.	Hydraulic mines.	Drift mines.	Dredging.	Surface placer.	Total.
Alpine	$4,827					$4,827
Amador	2,054,689	$2,112	$100		$23,900	2,080,801
Butte	37,315	67,701	121,983	$1,632,507	87,079	1,946,585
Calaveras	1,531,588	65,102	42,976	115,951	31,419	1,787,036
Del Norte		3,117			4,200	7,317
Eldorado	285,751	18,226	33,481		39,251	376,709
Fresno	4,595				3,117	7,712
Humboldt	93	42,529			18,529	61,151
Inyo	135,788					135,788
Kern	1,381,511		1,200		2,030	1,384,741
Lassen	115,993					115,993
Los Angeles	12,351				50	12,401
Madera	75,103				100	75,203
Mariposa	424,749		1,304		2,000	428,053
Mono	266,286					266,286
Mendocino					37	37
Monterey	500				7,168	7,668
Nevada	2,620,844	106,730	173,001		30,539	2,931,114
Placer	201,302	119,500	347,019		122,520	790,341
Plumas	161,087	19,016	10,975		67,649	258,727
Riverside	7,419					7,419
Sacramento			41,928	348,990	19,800	410,718
San Bernardino	589,124				8,600	597,724
San Diego	326,685				6,000	332,685
San Luis Obispo		380			250	630
Shasta	1,011,085	600	3,300		17,182	1,032,167
Sierra	158,694	46,651	139,937		34,840	380,122
Siskiyou	348,301	243,947	11,325	6,827	192,196	802,596
Stanislaus	50,000					50,000
Trinity	189,441	269,921	625	8,500	70,626	539,113
Tulare	1,100					1,100
Tuolumne	1,643,461	5,000	4,400		3,685	1,656,546
Ventura	3,500				200	3,700
Yuba	5,204	17,651	400	74,263	43,148	140,666
Total	13,648,386	1,028,183	933,954	2,187,038	836,115	18,633,676

COLORADO.

By W. S. Ward.

PRODUCTION.

Although the mining of gold and silver and their associated metals in the State of Colorado during the year 1904 was not signalized by any phenomenal discoveries, as in the years when the Leadville and

Cripple Creek districts were first exploited, yet there has been a most healthful and encouraging growth, as shown by the increase of output and the consequent values.

Not only has there been an increase in output, due largely to more intelligent and comprehensive methods of development and exploitation, but the mining industry of Colorado seems to be rapidly freeing itself from the speculative and fictitious features which were so often associated with it, much to its discouragement and discredit. In place of these speculative movements has come an intelligent and conservative handling of economic problems associated with the mining and reduction of ore, the favorable results of which are indicated by the tabulated returns here given, which record the output of 578 producing mines of the State for the year 1904.

Production of gold, silver, copper, lead, and zinc in Colorado in 1904, by counties.

County.	Producing mines.	Tonnage.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
		Short tons.	*Fine ounces.*		*Fine ounces.*	
Boulder	52	23,905	18,794.28	$388,482	97,228	$55,665
Chaffee	14	12,777	3,377.86	69,818	49,874	28,555
Clear Creek	53	62,661	32,194.42	665,459	735,985	421,351
Custer	7	10,170	3,177.37	65,675	110,367	63,185
Dolores	10	7,727	2,002.43	41,391	100,194	57,358
Eagle	10	1,866	1,473.63	30,460	21,011	12,028
Gilpin	55	109,557	53,451.03	1,104,833	355,354	203,440
Gunnison	15	2,067	1,389.53	28,720	128,096	73,335
Hinsdale	11	5,591	372.00	7,692	39,283	22,488
Jefferson	1	....	140.00	2,894	25	14
Lake	66	663,487	56,886.30	1,175,841	4,820,596	2,759,792
La Plata	12	3,792	5,280.66	109,151	31,570	18,073
Larimer	1	6	.58	12	108	.62
Mesa	1	9	12.12	250	9	5
Mineral	10	124,278	10,908.93	225,487	1,666,309	953,961
Ouray	12	91,244	105,194.03	2,174,361	264,385	151,360
Park	12	4,202	9,256.16	191,324	57,064	32,670
Pitkin	36	109,770	47.00	971	2,150,035	1,230,895
Saguache	5	499	418.00	8,641	47,233	27,041
San Juan	31	233,663	83,997.55	1,736,229	1,584,938	907,387
San Miguel	25	233,316	83,639.95	1,728,838	1,329,184	760,958
Summit	37	35,475	9,793.84	202,443	292,149	167,255
Teller	102	597,819	701,710.11	14,504,350	66,638	38,150
Total	578	2,333,881	1,183,517.78	24,463,322	13,947,635	7,985,028

Production of gold, silver, copper, lead, and zinc in Colorado in 1904, by counties—Cont'd.

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Boulder	5,340	$668					$444,815
Chaffee	456,556	57,069	458,422	$20,055			175,497
Clear Creek	369,778	46,222	3,753,447	164,213	2,135,302	$106,765	1,404,010
Custer	10,910	1,268	1,200	52	300	15	130,195
Dolores	12,201	1,526	260,584	11,400	145,060	7,253	118,928
Eagle	27,042	3,380	323,969	14,173	3,080	154	60,195
Gilpin	604,791	75,599	125,731	5,501	113,000	5,650	1,395,023
Gunnison	1,864	233	19,820	867			103,155
Hinsdale	10,530	1,316	1,054,421	46,129	101,086	5,054	82,679
Jefferson							2,908
Lake	3,627,846	453,480	54,392,821	2,379,686	92,005,179	4,600,260	11,369,059
La Plata	2,374	297	30	1	80	4	127,526
Larimer	3,780	473					547
Mesa							255
Mineral			9,304,854	407,088	2,480,178	124,009	1,710,545
Ouray	431,048	53,881	1,771,523	77,505	5,016	251	2,457,358
Park			156,270	6,837	69,000	3,450	234,281
Pitkin	2,908	363	9,071,761	396,890	44,375	2,219	1,631,338
Saguache	48,066	6,011	18,000	787	18,000	900	43,380
San Juan	3,575,219	446,902	10,303,414	450,774	1,384,340	69,217	3,610,509
San Miguel	245,709	30,714	6,184,375	270,567			2,791,077
Summit			5,592,140	244,658	2,512,778	125,639	739,995
Teller							14,542,500
Total	9,435,962	1,179,402	102,792,782	4,497,183	101,016,774	5,050,840	43,175,775

This table shows an increase in the value of the gold production of more than $3,000,000 over 1903, accompanied by marked advances in silver and zinc, and proves that though the year 1904 was not marked by any distinctively initiative movements, yet such decided progress has been made in advancing those already under way that the year 1905 is likely to show changes worthy of note. In general, the industry seems to have held its own throughout all the mineral-producing areas of the State, though the main source of the increase of gold, as might be expected, is the phenomenal camp of Cripple Creek.

The marked features of this new era of economical and practical progress may be referred to under four special heads: (1) Development of veins and deposits by tunnels, both adit and crosscut; (2) the use of new appliances for the concentration of ores, thus reducing the expense of transportation and consequent treatment; (3) the application of electricity to the concentration and isolation of zinc; (4) the adaptation of modern steam dredges to the handling of placer dirt and deposits.

These causes have brought about special advances in the counties of Teller, Lake, Summit, Clear Creek, and Gilpin.

Before referring to these counties in detail the consideration of the facts presented in the following table will be found of interest, since it shows the relative percentage of values obtained from mines the average yearly production of which varies from $1,000 and under to $500,000 and over, respectively. From this table it will be seen that those mines producing above $500,000 represent 40 per cent of the total output, though only 2 per cent in number.

Relative percentage of mines and of value of products in Colorado in 1904.

Production.	Mines.	Value of product.
	Per cent.	*Per cent.*
Up to $1,000	29.00	0.17
$1,000 to $5,000	28.00	1.76
$5,000 to $10,000	9.64	1.90
$10,000 to $50,000	15.63	6.83
$50,000 to $100,000	6.78	7.85
$100,000 to $500,000	8.35	39.97
Over $500,000	2.00	40.82

The following table will convey significant information as to the relative value of ores from 8 of the representative counties of Colorado:

Average value of gold, silver, copper, lead, and zinc in Colorado in 1904, per ton of ore, by counties named.

County.	Gold.	Silver.	Copper.	Lead.	Zinc.
Gilpin	$10.08	$1.85	$0.70	$0.20	$0.05
Teller	24.26	.06			
Lake	1.77	4.16	.66	3.88	6.93
Ouray	23.83	1.66	.58	.85	Trace.
Saguache	17.31	54.19	12.05	1.58	1.80
Pitkin	Trace.	11.21	Trace.	3.62	.02
Mineral	1.81	7.67		3.27	1.00
San Miguel	7.22	3.26	.13	1.16	Trace.

The following table shows the source of the gold and silver, by classes of ore:

Distribution of product of gold and silver in Colorado in 1904, by classes of ore.

[Fine ounces.]

Source.	Gold.	Silver.
Placer	7,022	30
Dry and siliceous ores	1,097,870	7,383,097
Lead ores	70,641	4,427,895
Copper ores	3,288	131,695
Zinc and zinc-lead ores	4,697	2,004,918
Total	1,183,518	13,947,635

IDAHO.

By V. C. Heikes.

PRODUCTION.

The total value of the gold and silver output of Idaho in 1904 was $6,099,369, an increase of $786,460 over that of the preceding year. The total gold mined in Idaho during the year 1904, according to reports returned by producers, was 82,739 fine ounces, valued at $1,710,365. The gold yield for 1903 was 65,850 fine ounces, valued at $1,361,119, an increase for 1904 of 16,889 ounces in quantity and of $349,246 in value as compared with 1903.

In 1904 Idaho produced 7,666,382 fine ounces of silver of commercial value, at 57.25 cents per ounce, of $4,389,004, an increase of 267,412 fine ounces and of $437,214, partly due to the increase in price. The following table shows the gold and silver product of Idaho compared with 1903:

Production of gold and silver in Idaho, 1903–1904, by mines.

	1903.		1904.		Increase in quantity.
	Quantity.	Value.	Quantity.	Value.	
Deep mines:					
Gold.........ounces..	47,523	$982,300	58,890	$1,217,363	11,367
Silver.........do....	7,392,912	3,948,554	7,658,760	4,384,640	265,848
Placer mines:					
Gold.........ounces..	18,327	378,819	23,849	493,002	5,522
Silver.........do....	6,058	3,236	[a] 7,622	4,364	1,564
Total..........	....	5,312,909	....	6,099,369	....

[a] Silver was not generally reported with placer gold in 1904. On this account an estimate, based on the average fineness of gold reported, is added to the total output.

Commercial value of silver per ounce:

1903..........	53.41
1904..........	57.25

The gold and silver returns from deep mines show that 1,668,327 tons of ore were crushed, which yielded in 1904 the sum of $5,602,003. The deep mines yielded in 1903 the sum of $4,930,854, so that the figures of 1904 show that they increased their yield $671,149. From the placer or surface mines the quantity of material washed was not reported. The value of the yield of gold in 1904 amounted to the sum of $493,002, an increase over the yield in 1903 of $114,183. Thus it is shown that both deep and placer mines are increasing their product.

In the report of precious metals production for 1903, the Survey did not take into account the entire output of Snake River placers. Snake River winds its way through and on the border of twelve counties. These are Fremont, Bingham, Bannock, Oneida, Blaine, Cassia, Lincoln, Owyhee, Elmore, Ada, Canyon, and Washington. For a distance of over 400 miles flour gold is produced in considerable quantities from its sands. To find a means of saving it completely has baffled the inventive genius of the miners. The use of burlap tables is at present the most effective for the small operators. The suction dredge has been successful at several points along the river. Many operators not reporting in this region in 1903 were heard from in 1904. The production of gold from this source alone amounted to 1,541 fine ounces, valued at $31,856, which makes quite an important item in the total value of the output for the State.

The deep mine and placer gold output was increased principally in the regions about Boise basin and West View district, in Boise County; Thunder Mountain and Warren districts, in Idaho County; Indian district, in Lemhi County; and Snake River, in Oneida County. The principal decrease was Yankee Fork district, of Custer County.

The yield in gold from placers might have been greater in 1904 than it was but for the general shortage of water, and the Coeur d'Alene region suffered during the last two months of 1904 from the same cause, which resulted in a decrease in the output of lead-silver ores, thereby decreasing the silver yield. However, on account of the increased output of lead ores carrying silver in Blaine County, the State total production of silver showed an increase. The silver output of Blaine County for 1905 will probably show a greater increase than it has had since the low prices of silver began. Many of the once famous silver-lead mines were opened in 1904, in anticipation of the opening of a custom milling plant, which would eliminate the excess of zinc that predominates in some of the low-grade ores. The mill is in course of construction by the Wood River Zinc Company, of Hailey. Modern concentrators and other devices to make a close saving will be installed in the mill. More milling plants were purchased by Idaho mining companies than in any previous year, more mining companies were incorporated, and more money was spent in development work and actual operation of mines.

The gross quantity and value of the principal metals besides gold and silver produced in Idaho for the year 1904, reported by mine operators and estimated at the average commercial price for the year, were: Copper, 5,087,518 pounds, value $635,940; lead, 233,096,375 pounds, value $10,197,966. The total value for the State, including gold and silver, was $16,933,405, an increase over 1903 of $2,406,572. This is shown in the following table:

Quantity and value of gold, silver, lead and copper produced in Idaho in 1903 and 1904.

	1903.		1904.		Increase in quantity.
	Quantity.	Value.	Quantity.	Value.	
Gold ....ounces..	65,850	$1,361,119	82,739	$1,710,365	16,889
Silver ....do....	7,398,970	3,951,790	7,666,382	4,389,004	267,412
Copper ....pounds..	569,484	78,589	5,087,518	635,940	4,518,034
Lead ....do....	213,143,618	9,135,335	233,096,375	10,197,966	19,952,757
Other metals	....	....	26,125	130	26,125
Total	....	14,526,833	....	16,933,405	....

The lead output is the chief source of the mineral wealth of Idaho. This metal comes principally from the mines about Wardner, Mullan, Mace, Gem, and Burke, in the Coeur d'Alene region. The production was increased from the vicinity of Hailey, in Blaine County; and also from Custer, Kootenai, and Lemhi counties. From the headquarters of a mining company at Hailey, a new district was reported near the headwaters of the South Payette and Middle Boise rivers, in Boise County. This new find is expected to produce lead and silver in sensational quantities from veins that are being developed, which equal in size those in the Coeur d'Alene region. The silver output of the State is largely stimulated by the mining of the lead product. The copper production has also increased from 569,484 pounds in 1903 to 5,087,518 pounds in 1904, or 4,518,034 pounds, valued at $557,351. This product was reported from Bannock, Boise, Custer, Lemhi, Shoshone, and Washington counties. Extensive developments in mines of copper-bearing ore are recorded from other counties, which may be heard from another year.

The statistical tables appearing in the following sections of this report for the year 1904 show the quantity and value of the production of the noble and base metals of the State. Their origin by classes and counties, together with the final disposition of the ores and bullion sold or treated, have been obtained from confidential returns furnished by the producers in the State. The distribution of gold, silver, lead, and copper, and the quantities produced are given by counties for 1903 and 1904 in the tables following.

Production of gold, silver, lead, and copper, in Idaho, in 1904, by counties.

County.	Gold.		Silver.		Lead.		Copper.	
	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.
	Fine oz.	*Fine oz.*	*Fine oz.*	*Fine oz.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Ada and Bannock	752	144	....	326	....	....	....	([a])
Bingham	501	478	....	....	....	....	....	....
Blaine	50	191	334,393	488,275	5,423,027	5,586,119	....	....
Boise	7,533	14,265	8,432	38,330	....	....	([a])	([a])
Canyon	3	8	....	....	....	....	....	....
Cassia	233	281	4	17	....	....	....	....
Custer	5,949	3,664	130,560	36,331	156,301	234,713	....	([a])
Elmore	2,713	3,368	265	1,489	....	....	....	....
Fremont	5	4	80	....	....	....	([a])	....
Idaho	12,777	14,584	6,026	6,760	....	....	....	....
Kootenai	624	1,339	14,448	26,969	20,000	280,700	....	....
Latah	334	293	....	....	....	....	....	....
Lemhi	8,819	12,188	10,434	44,475	380,720	1,827,400	([a])	([a])
Lincoln	79	161	....	....	....	....	....	....
Nez Perce	705	857	1,800	752	....	....	....	....
Oneida	191	431	6	....	....	....	....	....
Owyhee	19,665	23,584	762,604	802,290	....	....	....	....
Shoshone	2,195	2,226	6,069,918	6,143,001	207,163,570	225,167,443	....	([a])
Washington	2,722	2,173	60,000	70,367	....	....	([a])	([a])
Undistributed	....	2,500	....	7,000	....	....	....	....
Total	65,850	82,739	7,398,970	7,666,382	213,143,618	233,096,375	569,484	5,087,518
Increase	....	16,889	....	267,412	....	19,952,757	....	4,518,034

[a] Copper production by counties is omitted in order not to disclose individual production. The letter ([a]) indicates the counties producing copper.

The most noteworthy feature in connection with the gold production in Idaho is the marked and rapid advance of the quartz mining industry. The increase in gold from this source did much to make up for the deficiency in other classes of ores in 1904.

In the following table the number of tons of ores produced from deep mines in Idaho and the number of producing deep mines are shown for 1903 and 1904, by counties:

Number of tons of ore from deep mines sold or treated, number of mines producing, and value of gold and silver contents in Idaho in 1903 and 1904, by counties.

County.	Total tons of ore sold or treated.		Number of quartz mines producing.		Total and average value gold and silver contents.			
					1903.		1904.	
	1903.	1904.	1903.	1904.	Total value.	Value per ton.	Total value.	Value per ton.
Ada and Bannock.	1,000	136	1	2	$14,987	$14.98	$2,129	$15.65
Blaine	24,360	25,030	7	9	179,132	7.35	279,620	11.17
Boise	2,773	17,923	12	20	29,902	10.78	112,234	6.26
Custer	27,117	74,084	7	10	171,931	6.34	74,961	1.01
Elmore	3,710	3,541	2	8	54,426	14.67	68,630	19.38
Fremont	23	....	1	....	42	1.82	....	....
Idaho	91,631	36,367	8	10	234,977	2.56	245,651	6.75
Kootenai	800	1,157	3	2	7,758	9.69	15,440	13.34
Lemhi	14,826	31,746	12	16	101,660	6.85	231,012	7.27
Nez Perce	186	332	3	4	733	3.94	4,793	14.43
Owyhee	55,458	59,036	4	5	813,612	14.67	946,318	16.02
Shoshone	1,348,393	1,410,245	18	20	3,283,472	2.43	3,537,561	2.50
Washington	8,523	8,730	3	6	88,315	10.36	83,654	9.58
Total	1,578,800	1,668,327	81	112	4,980,947	3.15	5,602,003	3.36

The following table shows the output of gold in Idaho for the years 1903 and 1904, by counties:

Production of gold in Idaho in 1903 and 1904, by counties.

[Fine ounces.]

County.	1903.		1904.		Increase (+) or decrease (–) in quantity.
	Quantity.	Value.	Quantity.	Value.	
Ada and Bannock	752	$15,544	144	$2,977	– 608
Bingham	501	10,356	478	9,881	– 23
Blaine	50	1,033	191	3,948	+ 141
Boise	7,533	155,707	14,265	294,884	+ 6,732
Canyon	3	62	8	166	+ 5
Cassia	233	4,816	281	5,809	+ 48
Custer	5,949	122,965	3,664	75,742	– 2,285
Elmore	2,713	56,078	3,368	69,623	+ 655
Fremont	5	103	4	83	– 1
Idaho	12,777	264,101	14,584	301,478	+ 1,807
Kootenai	624	12,898	1,339	27,679	+ 715
Latah	334	6,904	293	6,057	– 41
Lemhi	8,819	182,289	12,188	251,948	+ 3,369
Lincoln	79	1,633	161	3,328	+ 82
Nez Perce	705	14,572	857	17,715	+ 152
Oneida	191	3,948	431	8,910	+ 240
Owyhee	19,665	406,475	23,584	487,524	+ 3,919
Shoshone	2,195	45,371	2,226	46,015	+ 31
Washington	2,722	56,264	2,173	44,919	– 549
Undistributed			2,500	51,679	
Total	65,850	1,361,119	82,739	1,710,365	+16,889

The gold product in Idaho originates principally in Owyhee, Boise, Idaho, and Lemhi counties, named in the order of importance. The gold product in Owyhee County comes mainly from quartz mines. Boise County leads in gold output from placer operations and in the increase of quartz mining industry. Idaho County seems to have increased its gold output principally from the Thunder Mountain region, although the Robbins district continues to hold first place in Idaho County. In Lemhi County the gold comes principally from the quartz ores of the Indian Creek district.

The distribution of the gold yield of Idaho for 1903 and 1904 is shown as follows:

Production of gold in Idaho in 1903 and 1904, by kinds of ore.

[Fine ounces.]

Year.	Placers.	Siliceous ores.	Ores cyanided.	Lead ores.	Copper ores.	Total.
1903	18,327	21,425	24,633	39	1,426	65,850
1904	23,849	39,397	18,855	100	538	82,739

The gold originating from placers came mainly from the following counties, named in order of production: Boise, Idaho, Lemhi, Kootenai, Shoshone, and Custer. The methods of working in use in placer mines were reported as follows: Sluicing, 153 mines; hydraulicking, 81; drifting, 6; dredging, 8. The value of the gold product from each method is shown in the following statement:

Product of placers in 1904, classified by method used.

[Fine ounces.]

Method of working.	Gold produced.	Per cent.
Sluicing	6,585	27.6
Hydraulicking	12,152	50.9
Drifting	317	1.4
Dredging	4,795	20.1
Total	23,849	100

Sluicing.—The 153 properties worked by the sluicing method were located, in Idaho County, 25; Boise, 18; Nez Perce, 7; Lemhi, 6; Snake River operators, 76; the remaining 21 being distributed in other counties.

Hydraulicking.—Of the 81 hydraulic properties, Boise County reported 28; Nez Perce, 13; Idaho, 11; Lemhi, 11; other counties, 18.

Drift mining.—This method was reported only from Idaho County, in the Simpson district, on the Salmon River. The county is credited with 6 properties.

Dredging.—Eight dredging companies reported production distributed as follows: Boise County, 3; Bingham, 1; Custer, 1; Lemhi, 1; Shoshone, 1; and Ada, 1.

The following table shows the gold produced in Idaho in 1903 and 1904 by the different methods of working placers:

Gold production of Idaho placers by different methods in 1903 and 1904.

[Fine ounces.]

Year.	Gold.				Total.
	Sluicing.	Hydraulicking.	Drift mining.	Dredging.	
1903	4,662	9,060	560	4,045	18,327
1904	6,585	12,152	317	4,795	23,849

Extraction by direct treatment by the cyanide process is in use in two counties, Owyhee and Washington, and is combined with amalgamation in Boise County in 2 plants, in Custer in 2, and in Nez Perce in 1. From reports of tests made with the cyanide process, many more properties will be likely to use this method of treatment, direct and in combination, on ores in several counties, results of which will be reported for 1905.

Lead ores in Lemhi County, in Texas and Spring Mountain districts, yielded the largest quantity of gold; and gold was also associated in small quantities in the ores produced in Bayhorse district of Custer County, likewise in Warm Springs district of Blaine County.

The copper ores of Washington County contained the largest quantity of gold per ton; and Custer County also records a good yield from its copper ores in Loon Creek and Alder Creek districts.

The following table shows the output of silver in Idaho for the years 1903 and 1904, by counties:

Production of silver in Idaho in 1903 and 1904, by counties.

[Fine ounces.]

County.	1903.		1904.		Increase (+) or decrease (−) in quantity.
	Quantity.	Value.	Quantity.	Value.	
Ada and Bannock			326	$186	+ 326
Blaine	334,393	$178,599	488,275	279,537	+153,882
Boise	8,432	4,504	38,330	21,944	+ 29,898
Cassia	4	2	17	10	+ 13
Custer	130,560	69,732	36,331	20,800	− 94,229
Elmore	265	142	1,489	852	+ 1,224
Fremont	80	43			− 80
Idaho	6,026	3,218	6,760	3,870	+ 734
Kootenai	14,448	7,717	26,969	15,440	+ 12,521
Lemhi	10,434	5,573	44,475	25,462	+ 34,041
Nez Perce	1,800	961	752	431	− 1,048
Oneida	6	3			− 6
Owyhee	762,604	407,307	802,290	459,311	+ 39,686
Shoshone	6,069,918	3,241,943	6,143,001	3,516,868	+ 73,083
Washington	60,000	32,046	70,367	40,285	+ 10,367
Undistributed			7,000	4,008	
Total	7,398,970	3,951,790	7,666,382	4,389,004	+267,412

The diminished operations of the Coeur d'Alene mines during the last two months of the year had much to do in not making the total output greater for the State in 1904.

From the following table the source of the silver in Idaho is given in fine ounces for the years 1903 and 1904, by kinds of ore:

Production of silver in Idaho in 1903 and 1904, by kinds of ore.

[Fine ounces.]

Year.	Placer.	Siliceous ores.	Ores cyanided.	Lead ores.	Copper ores.	Total.
1903	6,058	712,667	157,950	6,426,941	95,354	7,398,970
1904	7,622	824,843	42,600	6,589,474	201,843	7,666,382

Placer operators in 1904 were not requested on the inquiry cards to make report of silver paid for in bullion shipped to the mint, and accordingly the silver from this source is partly estimated for 1904.

Silver in quartz or siliceous ores increased mainly from the output in West View district, Boise County, and Carson, Flint, and French districts, Owyhee County. Silver from ores cyanided decreased in quantity in Owyhee and Custer counties.

Lead ores increased the silver yield in the Coeur d'Alene region of Shoshone County, in Spring Mountain and Texas districts of Lemhi County; also in Lava Creek, Mineral Hill, and Warm Springs districts of Blaine County and in Bayhorse district of Custer County.

The increased output of copper ores has caused the yield of silver to be increased in Shoshone and Custer counties.

The reports returned from mine operators in Idaho numbered 1,063. Of this number, 619 lode mines and 84 placers reported development and assessment work. The remainder, 360, were producing properties. One hundred and twelve of these were quartz or lode mines and 248 were placer mines. In addition, 107 reduction works at mines, 15 dredges, and 2 smelters were reported.

Of the 107 reduction works connected with mines, 63 mills (including 3 arrastras), 8 dredges, and 2 copper smelters were in operation; 44 mills (including 5 arrastras) and 7 dredges were idle. Of the 50 operating quartz mills, 32 used stamps for crushing the ores. Eighteen used crushers and rolls of various patterns. Twelve of the 50 operating mills used direct amalgamation with batteries and plates, 16 used amalgamation followed by concentration, and 5 used amalgamation followed by treating the tailings with cyanide. Thirteen were concentrating plants, and 2 used direct treatment of the crushed ores by cyanide.

ORES SOLD OR TREATED.

Mine operators in Idaho reported on cards prepared for the purpose the total number of ounces or pounds of metal, including gold, silver, lead, copper, and zinc, produced for the calendar year. When the report was thus made, the average commercial price was used in obtaining the value. When values only were given, if consistent, they were allowed to remain. The total tonnage of ore smelted and milled, of concentrates produced, and of old tailings treated by cyanide, with the total values of each summed up, are as follows:

Tonnage and value of ore treated in Idaho in 1904.

[Short tons.]

	Tonnage.	Reported value.
Ores shipped to smelters	157,606	$3,662,844
Ores milled	1,510,121	107,309
Concentrated ores	162,951	8,855,962
Old tailings treated by cyanide	600	3,962
Bullion from placer mining to mint		497,351
Total		13,127,428

As has been shown at the commencement of this section, the total output of Idaho, estimated at commercial prices for the year, equals the sum of $16,933,405; the difference between this amount and the sum recovered from ores sold or treated is $2,841,977. This sum shows in a measure the smelting and refining charges on the total output of the State. The shipment of concentrates and ores to smelters was 320,557 tons; accordingly, the average value per ton not reported, which was either freight or smelting charges, amounted to $8.86.

It is found by the figures given by the mine operators in Idaho for 1904, that for ores sold or treated, not including placer bullion, the gold averages $19.65 per ounce, silver 55.35 cents per ounce, copper 11.74 cents per pound, and lead 3.26 cents per pound. Ores shipped and treated at smelters during 1904 from Idaho properties amounted to 157,606 tons, on which was realized $3,662,844 for the gold, silver, lead, copper, and zinc contents of the ores—an average value of $23.24 per ton.

The largest part of the ore mined in Idaho is concentrated and shipped out of the State to smelters. The concentrated ores are produced in greatest quantity in the Coeur d'Alene region in the form of lead concentrates. The copper ore of the Coeur d'Alene is shipped to smelters at Tacoma, Wash., and Butte, Mont. A small quantity of copper ore is reduced in other counties at local smelters and the copper bullion is shipped to eastern refineries.

The total quantity of ore milled was 1,510,121 tons, and from 1,400,110 tons of ore concentrates were produced to the amount of 162,951 tons. The average degree of concentration was accordingly 1 ton of concentrates to about 8 tons crude ore. From the 162,951 tons of concentrates, $8,855,962 was realized for the gold, silver, lead, and copper contents—an average of $54.34 per ton. In addition, gold and silver bullion extracted from 153,044 tons of ore treated by amalgamation and cyanidation, was shipped to the United States mint and assay offices and amounted in value to $1,071,309—average value of $7.01 per ton of ore treated. From 600 tons of old tailings, $3,962 was realized from bullion and cyanide product; the tailings yielded an average of $6.60 per ton.

MONTANA.

By Alexander N. Winchell.

PRODUCTION.

The production of precious metals in Montana during the year 1904, as reported to the United States Geological Survey, was as follows:

Production of gold and silver in Montana in 1904.

[Fine ounces.]

	Quantity.	Value.
Gold	206,419.45	$4,267,062
Silver	12,817,285.00	7,334,146
Total		11,601,208

The gold is calculated at the coinage rate of $20.6718 per fine ounce, and the silver is reckoned at the average commercial value for the year, which was 57.221 cents per fine ounce.

If these results be compared with the total production as reported by the assay office of the United States Mint at Helena, Mont., the following table results:

Production of gold and silver in Montana in 1904, as reported by United States Geological Survey and by United States assay office.

[Fine ounces.]

	U. S. Geological Survey.		Assay office.	
	Quantity.	Value.	Quantity.	Value.
Gold	206,419.45	$4,267,062	246,606	$5,097,800
Silver	12,817,285.00	7,334,146	14,608,100	8,472,698
Total		11,601,208		13,570,498

All the important metal producers of the State have reported to the Survey, and although some small producers may have been overlooked, it is believed that the chief cause of the difference in these figures is to be found in the possibility that the gold brought to the Helena assay office from sources outside the State is sometimes credited to Montana, and in the further possibility that some of the gold reported by the assay office is remelted gold of the arts. This supposition is corroborated by the fact, that a similar difference exists between the total production of the precious metals as given by the assay office and as reported by the Bureau of the Census for the year 1902. This is shown in the following table:

Production of gold and silver in Montana in 1902, as reported by United States Census and by United States assay office.

[Fine ounces.]

	Census.		Assay office.	
	Quantity.	Value.	Quantity.	Value.
Gold	197,535	$3,990,359	212,855	$4,400,096
Silver	13,441,950	6,833,963	13,629,737	7,223,761
Total		10,824,322		11,623,857

It appears, therefore, that in order to judge of the progress of precious-metal mining in the State during the last two years a useful comparison can be made between the values reported to the Survey in 1904 and those reported to the Census in 1902.

Production of gold and silver in Montana, as reported by United States Geological Survey in 1904 and by United States Census in 1902.

[Fine ounces.]

	Census—1902.		Survey—1904.	
	Quantity.	Value.	Quantity.	Value.
Gold	197,535	$3,990,359	206,419.45	$4,267,062
Silver	13,441,950	6,833,963	12,817,285.00	7,334,146
Total		10,824,322		11,601,208

This indicates an increase in the gold production of $276,703, or nearly 7 per cent; and, on account of the higher average value of silver during 1904, the total value of the silver shows an increase of $500,183, or more than 7 per cent, although the silver shows a decrease in quantity of 624,665 ounces, or a little more than 4.5 per cent.

The production of gold and silver in Montana during the year was derived from the following counties:

Production of gold and silver in Montana in 1904, by counties.

[Fine ounces.]

County.	Gold.		Silver.		Total value.
	Quantity.	Value.	Quantity.	Value.	
Beaverhead	451.95	$9,343	59,870	$34,258	$43,601
Broadwater	1,882.60	38,917	42,231	24,167	63,084
Cascade	6.25	129	204,574	117,059	117,188
Chouteau, Meagher, and Sweet Grass	5,118.20	105,802	8,173	4,676	110,478
Deerlodge	7,381.95	152,598	12,000	6,866	159,464
Fergus	61,168.50	1,264,463	1,519	839	1,265,302
Flathead	1,043.90	21,579	10,925	6,251	27,830
Granite	4,331.10	89,532	1,293,296	740,036	829,568
Jefferson	7,202.40	148,887	331,091	189,454	338,341
Lewis and Clark	29,437.75	608,531	177,489	101,561	710,092
Madison	31,385.20	648,789	125,489	71,806	720,595
Missoula	1,864.50	38,543	45	25	38,568
Park	3,073.00	63,524	3,333	1,907	65,431
Powell	4,222.10	87,278	16,668	9,537	96,815
Ravalli	875.65	18,101			18,101
Silverbow	46,974.40	971,046	10,530,582	6,025,704	6,996,750
Total	206,419.45	4,267,062	12,817,285	7,334,146	11,601,208

From this table it appears that Fergus County still leads in the production of gold, a position which it assumed in 1903. Indeed, it has increased its lead over Silverbow County so far as to produce 30 per cent more than the latter during 1904. This is due to the continued success of the large cyaniding plants operating in the county. Madison County, largely on account of extensive dredging operations in Alder Gulch, is third in rank, followed closely by Lewis and Clark County.

Silverbow County produced over 82 per cent of all the silver won during the year. The larger portion of this was obtained from the smelting of copper ores, a small quantity being obtained from gold-silver ores. Granite County is second as a silver producer, being credited with 10 per cent of the total.

The gold won during the year was obtained from the following sources as to character of ore:

Gold production in Montana in 1904, classified by kinds of ore, by counties.

[Fine ounces.]

County.	Placer.	Siliceous ores.	Lead ores.	Copper ores.	Total.
Beaverhead	136.60	257.35	26.85	31.15	451.95
Broadwater	687.85	553.05	641.70	....	1,882.60
Cascade	....	6.25	....	....	6.25
Chouteau, Meagher, and Sweet Grass	....	5,068.20	....	50.00	5,118.20
Deerlodge	211.40	7,170.55	....	....	7,381.95
Fergus	....	61,168.50	....	....	61,168.50
Flathead	812.65	....	231.25	....	1,043.90
Granite	821.75	3,509.35	....	....	4,331.10
Jefferson	71.25	7,006.25	120.90	4.00	7,202.40
Lewis and Clark	677.55	28,760.20	....	....	29,437.75
Madison	13,489.05	16,320.90	1,110.00	465.25	31,385.20
Missoula	1,864.50	....	....	....	1,864.50
Park	69.60	3,003.40	....	....	3,073.00
Powell	848.60	3,373.50	....	....	4,222.10
Ravalli	875.65	....	....	....	875.65
Silverbow	....	3,084.50	....	43,889.90	46,974.40
Total	20,566.45	139,282.00	2,130.70	44,440.30	206,419.45

Of the total production of gold over 70 per cent was obtained from siliceous ores, over 18 per cent from copper ores, and nearly 10 per cent from placers. Madison County easily leads in production of placer gold; Fergus County produces the most gold from siliceous ores and Silverbow County from copper ores.

The silver product of the year was obtained from ore of the same classes as shown in the following table:

Silver production in Montana in 1904, classified by kinds of ore, by counties.

[Fine ounces.]

County.	Placer.	Siliceous ores.	Lead ores.	Copper ores.	Total.
Beaverhead	30	26,036	21,227	12,577	59,870
Broadwater	20	1,361	40,850	....	42,231
Cascade	....	7,623	196,951	....	204,574
Chouteau, Meagher, and Sweet Grass	....	6,173	....	2,000	8,173
Deerlodge	....	12,000	....	....	12,000
Fergus	....	1,519	....	....	1,519
Flathead	....	....	10,925	....	10,925
Granite	18	1,293,278	....	....	1,293,296
Jefferson	19	154,337	173,985	2,750	331,091
Lewis and Clark	180	171,954	5,355	....	177,489
Madison	15	110,331	15,143	....	125,489
Missoula	45	....	....	....	45
Park	....	3,333	....	....	3,333
Powell	....	16,668	....	....	16,668
Silverbow	....	311,790	....	10,218,792	10,530,582
Total	327	2,116,403	464,436	10,236,119	12,817,285

Of the total silver production about 80 per cent was derived from copper ores from Silverbow County, and more than 16 per cent came from siliceous ores. Granite County leads in the production of silver from siliceous ores; Cascade County produced the most silver from lead ores, followed closely by Jefferson.

The reports that have been received for the mines of Montana during 1904 show that 210 mines were productive, of which 73 were placer mines. These may be tabulated as follows:

Montana mines reporting in 1904, by counties.

County.	Producing mines.			Reporting, but nonproducing.	Grand total.
	Placer.	Quartz.	Total.		
Beaverhead	4	4	8	16	24
Broadwater	6	8	14	8	22
Cascade		4	4		4
Chouteau		1	1		1
Deerlodge	3	3	6		6
Fergus		5	5	2	7
Flathead	2	1	3		3
Granite	6	10	16	5	21
Jefferson	4	15	19	9	28
Lewis and Clark	23	9	32	5	37
Madison	12	28	40	11	51
Meagher		1	1	4	5
Missoula	5		5		5
Park	2	2	4	1	5
Powell	3	8	11		11
Ravalli	3		3		3
Silverbow		37	37	41	78
Sweet Grass		1	1		1
Total	73	137	210	102	312

The following table of the number of tons of ore milled and smelted, or the total tonnage sold or treated during the year, shows that Silverbow County is the source of about 90 per cent of the total:

Number of tons of ore treated in Montana in 1904, by counties.

[Short tons.]

County.	Quantity.	County.	Quantity.
Beaverhead	12,570	Jefferson	34,377
Broadwater	1,350	Lewis and Clark	126,830
Cascade	2,271	Madison	38,202
Chouteau, Meagher, and Sweet Grass	26,564	Park	2,482
Deerlodge	18,900	Powell	3,119
Fergus	224,342	Silverbow	4,102,604
Flathead	15,782	Total	4,643,092
Granite	33,699		

The production of copper and lead during the year may be tabulated as follows, with the total value of the production of all the metals from the various counties:

Production of copper and lead in Montana in 1904, and total value of metals, by counties.

[Pounds.]

County.	Copper.		Lead.		Total value of gold, silver, copper, and lead.
	Quantity.	Value.	Quantity.	Value.	
Beaverhead	543,126	$69,645	107,081	$4,614	$117,860
Broadwater			295,749	12,743	75,827
Cascade			718,308	30,952	148,140
Chouteau, Meagher, and Sweet Grass	75,000	9,617			120,095
Deerlodge					159,464
Fergus					1,265,302
Flathead			547,869	23,608	51,438
Granite					829,568
Jefferson	11,100	1,423	401,515	17,301	357,065
Lewis and Clark	7,067	906	35,688	1,538	712,536
Madison	11,300	1,449	185,881	8,010	730,054
Missoula					38,568
Park					65,431
Powell	1,000	128	7,200	310	97,253
Ravalli					18,101
Silverbow	290,032,979	37,190,929			44,187,679
Total	290,681,572	37,274,097	2,299,291	99,076	48,974,381

The value of copper is computed at the average rate for the year 12.823 cents per pound and the lead is calculated at 4.309 cents per pound.

The preeminence of Silverbow County is well illustrated in this table, which shows that it produces over 99.5 per cent of the value of the copper product of the State, and over 90 per cent of the total combined value of the gold, silver, copper, and lead.

NEVADA.

By Charles G. Yale.

PRODUCTION.

Returns received from Nevada indicate a production in 1904 of $5,060,494 in gold, $2,432,830 in silver, $3,115 in copper, and $161,777 in lead, a total of $7,658,216.

Practically all the producing mines of the State reported their 1904 output, and the returns show a large increase over both the Survey and mint figures for 1903.

Gold shows an increase of $1,990,144 over the 1903 Survey returns and of $1,672,494 over the 1903 mint returns, and silver an increase of $333,918 over the 1903 Survey returns, a total increase over 1903 Survey returns of $2,324,062.

There has been some difficulty in obtaining reports from lessees who mined ore under 1903 leases, which ore was not shipped or sold until 1904, but in most cases the owners of the mine have given approximate figures and in every way possible facilitated the work of obtaining accurate figures. The Survey mining lists have been corrected and revised in the various mining districts, and while there may be unreported prospectors who are doing work, every producing mine has been reported on.

There were 653 mining operators who replied to the requests for information; 158 were producers in 1904, and 495 did development or assessment work. Of the producing mines, 143 were quartz and 15 were placers; of the assessment or development claims, 486 were quartz and 9 were placers.

The following table shows the kind of reporting mines in the various counties:

Reporting mines in Nevada in 1904, by counties.

County.	Producing mines.		Development or assessment mines.	
	Placer.	Quartz.	Placer.	Quartz.
Churchill	....	3	....	9
Douglas	4	2	....	7
Elko	4	9	3	21
Esmeralda	....	24	....	83
Eureka	....	10	....	14
Humboldt	2	5	1	50
Lander	....	7	....	20
Lincoln	....	15	....	67
Lyon	1	10	....	20
Nye	....	10	....	75
Ormsby	....	1	....	10
Storey	....	15	....	27
Washoe	....	11	....	43
White Pine	4	21	5	40
Total	15	143	9	486

The largest aggregate output shown by any county was in Esmeralda County, where Goldfield is situated. The increase in gold for this county over 1903 is the extremely large sum of $2,221,818, and Goldfield district alone had a production of over $2,300,000 from about 8,000 tons of ore, the remaining mining districts in the county showing a small loss in both gold and silver. High-grade ores only were shipped from Goldfield, the ore being teamed to Tonopah. A large quantity of the ore remained on the dumps and will either be shipped when a railroad is extended to the camp or will be reduced at one of the custom mills which will be operating in 1905.

The Jumbo Mining Company and the Combination Mining Company have both erected mills and were large producers in 1904. Other

1904 producers were Diamondfield Gold Mining Company, Goldfield Mining Company of Nevada, Sandstorm Mining Company, Florence Mining Company, and St. Ives Gold Mining Company; these and many others will be large producers in 1905, and the production should then show a large increase even if no extemely rich ore is treated, for the large ore dumps and extensive development with improved treatment facilities make the increase possible. Very little silver was produced at Goldfield and only $74,338 from the entire county, the total metallic product of the county being $2,496,363, of which $2,411,449 was gold. The Bullfrog district is being actively developed; large ore bodies of high grade have been located, and some ore will be shipped in 1905.

Nye County, which was the leading producer in 1903, stands second in 1904, with a total of $1,695,680, of which $446,725 is gold and $1,243,575 silver, the silver product being about one-half of the whole amount produced in the State. The railway to the Tonopah camp was completed July, 1904, but being a narrow-gage road it was overwhelmed with business, so that the ore shipments to smelters were much less than anticipated. The railway is being broad gaged in 1905, and its capacity will be more than doubled.

Production of precious metals in Nevada in 1904, by counties.

County.	Gold.		Silver.	Copper.		Lead.		Total value.
	Placer.	Deep.		Pounds.	Value.	Pounds.	Value.	
Churchill		$6,340						$6,340
Douglas	$4,613	1,230	$15,003					20,846
Elko	6,778	141,261	108,055	7,200	$792	137,269	$5,522	262,408
Esmeralda		2,411,449	74,338	300	39	280,285	10,537	2,496,363
Eureka		44,296	93,220	13,963	1,380	513,032	20,404	159,300
Humboldt	12,388	53,785	5,725					71,898
Lander		3,542	11,405	3,200	448	112,969	4,510	19,905
Lincoln		1,092,583	71,965			351,528	13,940	1,178,488
Lyon	1,013	130,365	40,228					171,606
Nye		446,725	1,243,575	70	9	134,200	5,371	1,695,680
Ormsby		36						36
Storey		636,563	728,942					1,365,505
Washoe		40,169	297					40,466
White Pine	5,400	21,958	40,077	4,584	447	2,700,444	101,493	169,375
Total	30,192	5,030,302	2,432,830	29,317	3,115	4,229,727	161,777	7,658,216
Grand total		5,060,494	2,432,830		3,115		161,777	7,658,216

Gold, fine ounces, 244,823; silver, 4,268,123.

Source of Nevada gold in 1904, by counties.

County.	Quartz.	Hydraulic.	Surface placer.	Total.
Churchill	$6,340			$6,340
Douglas	1,230	$897	$3,716	5,843
Elko	141,261	1,478	5,300	148,039
Esmeralda	2,411,449			2,411,449
Eureka	44,296			44,296
Humboldt	53,785		12,388	66,173
Lander	3,542			3,542
Lincoln	1,092,583			1,092,583
Lyon	130,365		1,013	131,378
Nye	446,725			446,725
Ormsby	36			36
Storey	636,563			636,563
Washoe	40,169			40,169
White Pine	21,958		5,400	27,358
Total	5,030,302	2,375	27,817	5,060,494

Source of gold and silver production of Nevada in 1904 by kinds of ore, by counties.

County.	Gold.			Total.	Silver.			Total.
	Siliceous ores.	Copper ores.	Lead ores.		Siliceous ores.	Copper ores.	Lead ores.	
Churchill	$6,340			$6,340				
Douglas	1,230			1,230	$15,003			$15,003
Elko	138,734		$2,527	141,261	102,672		$5,383	108,055
Esmeralda	2,405,851		5,598	2,411,449	24,411		49,927	74,338
Eureka	9,944	$168	34,184	44,296	60,612	$693	31,915	93,220
Humboldt	53,785			53,785	5,725			5,725
Lander	840	40	2,662	3,542	1,435	25	9,945	11,405
Lincoln	1,088,733		3,850	1,092,583	29,851		42,114	71,965
Lyon	130,365			130,365	40,228			40,228
Nye	445,765		960	446,725	1,212,465		31,110	1,243,575
Ormsby	36			36				
Storey	636,563			636,563	728,942			728,942
Washoe	40,169			40,169	297			297
White Pine	18,465		3,493	21,958	16,444	718	22,915	40,077
Total	4,976,820	208	53,274	5,030,302	2,238,085	1,436	193,309	2,432,830

The Tonopah Mining, Milling and Development Company erected and operated a 10-stamp custom mill in 1904 and the Tonopah Mining Company intend to build a 100-stamp mill in 1905. The largest producers at Tonopah in 1904 were the Tonopah Mining Company, Tonopah-Belmont Development Company, Montana Tonopah Mining Company, and Midway Mining Company. Extensive development work was done in other mines. The Jim Butler Mining Company, Tonopah Extension Mining Company, Tonopah California Mining Company, West End Mining Company, and others will be producers in 1905. Mines are being developed at Kawich, Reveille, and many other places. Reveille was a small producer in 1904. The discoveries at Tonopah brought hundreds of miners and prospectors who, finding the desirable locations there already taken up, spread all over the desert country south as far as the new railway from Salt Lake to Los Angeles.

Storey County occupies third place in 1904 and shows a large increase for the Comstock mines. Its production in 1904 was $636,563 in gold and $728,942 in silver, a total of $1,365,505, a large increase over 1903. The Ophir Mining Company, Silver Hill Mining Company, and the Consolidated California and Virginia were the largest producers, and considerably over $100,000 was recovered from old tailings by cyanide.

Lincoln County holds fourth place in 1904 for combined gold and silver, but shows a decrease of about $30,000 in the 1904 output of silver, while the gold recovered was practically the same as in 1903. For gold alone Lincoln County ranks second to Esmeralda, having produced $1,092,583.

Elko County, with a production of $141,261 in gold and $108,055 in silver, holds fifth place in 1904 and shows a slight increase over its 1903 output. The remaining counties, which rank as follows, Lyon, White Pine, Eureka, Humboldt, Washoe, Douglas, Lander, Churchill, and Ormsby, show the effect of the stampede to Esmeralda, Nye, and Lincoln counties during the last two years, and their output in 1904 shows a decrease; the last six months, however, show that the whole State is receiving the benefit of the influx of miners started by the Tonopah strike.

The placer gold output of Nevada in 1904 was only $30,192, reported by 15 producers, and all of this amount but $2,375 was obtained by sluicing. Humboldt County was the largest producer, with $12,388, followed by Elko, White Pine, and Douglas counties. Most of the Humboldt placer gold came from the vicinity of Lovelocks, that of Elko County from Mountain City, and all of that from White Pine County was obtained from bench gravels near Osceola.

NEW MEXICO.

By Fayette A. Jones.

PRODUCTION.

The year 1904 showed some revival in the mining industry of the Territory, there being an increase generally in the metallic production over that of 1903.

The following table shows the quantity and values of the metallic products mined during the year 1904:

Metallic production of New Mexico in 1904.

Metal.	Quantity.	Value.
Gold .... fine ounces..	18,476	$381,930
Silver (57.843 cents per ounce) .... do....	214,553	124,103
Copper (13 cents per pound) .... pounds..	4,972,170	646,382
Lead (4.30 cents per pound) .... do....	3,122,872	134,283
Zinc (5 cents per pound) .... do....	17,991,780	899,589
Total	....	2,186,287

The distribution of production by counties is given in the following tables:

Metallic production of New Mexico in 1904 from deep mines, by counties.

County.	Ore mined.	Ore sold or treated.	Gold.		Silver.	
			Quantity.	Value.	Quantity.	Value.
	Short tons.	*Short tons.*	*Fine ounces.*		*Fine ounces.*	
Colfax	700	380	176	$3,638	67	$39
Donna Ana	7,070	5,580	....	....	24,101	13,941
Grant	52,494	47,032	2,919	60,347	74,793	43,262
Lincoln	3,990	820	411	8,496	2,576	1,490
Luna	2,317	1,576	82	1,695	8,549	4,944
Otero	1,364	170	76	1,569	164	95
Rio Arriba	467	10	2	50	52	30
Sandoval	408	46	43	886	1,035	599
San Miguel	270	95	22	450	450	260
Santa Fe	466	170	63	1,292	....	....
Sierra	2,681	1,295	2,497	51,617	17,055	9,865
Socorro	47,250	45,065	4,910	101,506	85,471	49,439
Taos	585	100	47	960	240	139
Valencia	75	....	....	....	....	....
Total	120,137	102,339	11,248	232,506	214,553	124,103
From placer mines	....	....	7,228	149,424	....	....
Grand total	....	....	18,476	381,930	....	....

County.	Copper.		Lead.		Zinc.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Pounds.		*Pounds.*		*Pounds.*		
Colfax	....	....	....	....	....	....	$3,677
Donna Ana	40,000	$5,200	1,581,488	$68,004	....	....	87,145
Grant	4,428,508	575,706	179,142	7,703	....	....	687,018
Lincoln	....	....	2,261	97	....	....	10,083
Luna	16,000	2,080	671,772	28,886	....	....	37,605
Otero	14,400	1,872	....	....	....	....	3,536
Rio Arriba	846	110	....	....	....	....	190
Sandoval	....	....	....	....	....	....	1,485
San Miguel	24,900	3,237	....	....	....	....	3,947
Santa Fe	2,308	300	....	....	....	....	1,592
Sierra	16,700	2,171	....	....	....	....	63,653
Socorro	425,508	55,316	688,209	29,593	17,991,780	$899,589	1,135,443
Taos	3,000	390	....	....	....	....	1,489
Valencia	....	....	....	....	....	....	....
Total	4,972,170	646,382	3,122,872	134,283	17,991,780	899,589	2,036,863

Metallic production of New Mexico in 1904 from deep mines, by counties—Continued.

County.	Ore shipped to smelter.		Ore milled.		Concentrates shipped to smelter.		Tailings treated by cyanide.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Colfax			380	$3,677				
Donna Ana	440	$15,953	5,140	71,192	1,285	$71,192		
Grant	11,511	459,009	35,521	219,685	3,689	209,911	38	$344
Lincoln			820	10,083	25	1,044		
Luna	1,416	35,805	160	1,800	30	1,800		
Otero	170	3,536						
Rio Arriba	10	190						
Sandoval	46	1,485						
San Miguel	75	3,830	20	117				
Santa Fe	20	692	150	900				
Sierra	912	59,724	383	3,909	86	3,075		
Socorro	28,029	940,376	17,036	114,259	652	89,278	10,073	80,808
Taos	15	429	85	1,160				
Valencia								
Total	42,644	1,521,029	59,695	426,782	5,767	376,300	10,111	81,152

Production of placer gold in New Mexico in 1904, by counties.

[Fine ounces.]

County.	Quantity.	Value.	County.	Quantity.	Value.
Colfax	4,385	$90,639	Santa Fe	200	$4,135
Grant	391	8,081	Sierra	1,111	22,979
Lincoln	972	20,100	Socorro	8	166
Otero	51	1,050	Taos	40	827
Rio Arriba	21	434	Total	7,228	149,424
Sandoval	49	1,013			

Source of gold and silver product of New Mexico in 1904, by kinds of ore.

[Fine ounces.]

	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
From placers	7,229	$149,424		
From quartz (dry ore)	6,860	141,808	75,684	$43,778
From copper ores	4,137	85,525	79,369	45,909
From lead ores	250	5,173	59,500	34,416
Total	18,476	381,930	214,553	124,103

Average value of ores per ton in New Mexico in 1904.

	Short tons.	Average value.
Crude ore shipped to smelter	42,644	$35.67
Concentrates shipped to smelter	5,767	65.25
Ore milled or cyanided	59,695	7.15

During the year 1904 there were 28 milling plants in operation; no smelter was working during the year. There were 59,695 tons of ore milled, producing 5,767 tons of concentrates, valued at $376,300. Of the mill tailings there were 10,111 tons treated by cyanide, $81,152 in gold and silver values being recovered.

The county of Bernalillo, in which the city of Albuquerque is situated, has passed through a rapid decline in the production of precious metals; from having had the greatest output of any county in 1901 it has declined until it has passed, in 1904, entirely from the list of producing counties. The carving of new counties from the body corporate of Bernalillo has been responsible for the cessation in production, and the county may never take rank again as a producer of gold and silver, since its area has been reduced in such a manner as to embrace only one mountain range—the Sandias. These mountains lie immediately east of Albuquerque, and seem practically destitute of gold and silver. They contain, however, some indications of copper and lead, and some small bodies of high grade iron ore are said to be found; the iron ore is classed as limonite.

OREGON.

By Charles G. Yale.

PRODUCTION.

According to returns received from Oregon operators that State had a yield in 1904 of $1,412,186 in gold and $75,284 (commercial value) in silver. The copper yield was valued at $35,012, the lead at $310, the platinum at $1,912, and cobalt $65, a total of $1,524,769. Comparison of these figures with the Survey figures for 1903 shows that the gold yield is practically the same as in 1903, and that silver increased $13,043 in 1904, a total increase of $13,021. The yield was made by 84 producing quartz mines and 211 placers, hydraulic, surface, and dredging. The quartz mines produced $1,062,972 in gold, an increase over 1903 of $121,784, the increase being almost entirely in Baker County. The placer output was $349,214 in gold, a decrease of $121,806 caused by a shortage in water. Of the placer product of $349,214, the sum of $56,249 came from surface placers and $292,965 from hydraulicking and dredging. Two dredges commenced operations in 1904—one in Grant County and one in Jackson County—and another dredge was building in Grant County but was not operated. Separate figures for dredging can not be given without disclosing the private business of the two companies. The largest yield was as in 1903 from Baker County, followed in relative rank by the counties of Josephine, Jackson, Grant, Lane, Malheur, Wheeler, Curry, Douglas, Coos, Crook, Lincoln, and Wallowa.

The following statement shows the number of producing quartz and placer mines and the number on which development work or assessment was done in 1904 in the respective counties, as given in the returns received by the Geological Survey:

Producing and nonproducing mines in Oregon in 1904, by counties.

County.	Producing.		Development or assessment.	
	Quartz.	Placer.	Quartz.	Placer.
Baker	31	23	116	11
Coos	2	4	4	1
Crook	1	1	6	
Curry		14	6	5
Douglas		15	37	7
Grant	20	16	75	4
Harney			5	
Jackson	8	45	52	11
Josephine	18	74	66	21
Lane	1		56	
Lincoln		1		2
Marion			6	
Malheur	3	9	9	1
Union			6	
Wallowa		1	11	
Wheeler		8		2
Total	84	211	455	65

Out of 815 mines reporting, 295 were producing. During 1904 two smelters were blown in. The one at Sumpter, in eastern Oregon, is owned by the Oregon Smelting and Refining Company, and has a capacity of 100 tons every twenty-four hours, and will draw its own supplies from eastern Oregon and western Idaho. The other new smelter is that of the Takilma Smelting Company, at Takilma, Josephine County. The two smelters were only in operation for a few months the latter part of the year. Another smelter is to be erected at Grants Pass, Josephine County. These smelters will create a market for copper and gold ores that have not hitherto been shipped and will greatly stimulate development in many mining districts. The benefit of the smelter at Sumpter is shown by the largely increased number of producers in Baker County, and 1905 will probably show a largely increased output from several mines that were formerly large producers but that were idle in 1904. If normal water had prevailed in 1904 Oregon would have made a substantial increase.

The most extensive developments have been in Baker County, in eastern Oregon, and in Josephine and Lane counties, in western Oregon. Many new mines will be milling or shipping in 1905, and the output from dredges will add materially to the 1905 production.

Oregon produced $1,912 worth of platinum in 1904, an increase of $794. Coos, Josephine, Lincoln, Curry, and Douglas counties are the producers. Much interest is being taken in the investigation of the black sands now being made by the United States Geological Survey, and placer miners are now on the alert to save the platinum metals that very few miners attempted to save prior to 1904.

The source of gold in the counties of Oregon is shown by the following statement, Josephine and Lane counties being bracketed in order that the output of Lane County, which was practically contributed by one quartz mine, should not be disclosed:

Source and value of gold in Oregon in 1904, by counties.

County.	Quartz.	Hydraulicking and dredging.	Surface placer.	Total gold.
Baker	$738,973	$40,658	$11,197	$790,828
Coos	1,078	900	1,750	3,728
Crook	500	320		820
Curry		1,744	7,650	9,394
Douglas		7,768	1,050	8,818
Grant	59,925	20,205	2,150	82,280
Jackson	23,345	80,512	4,696	108,553
Josephine and Lane	229,608	126,872	17,190	373,670
Lincoln			540	540
Malheur	9,543	6,000	7,526	23,069
Wallowa			400	400
Wheeler		7,986	2,100	10,086
Total	1,062,972	292,965	56,249	1,412,186

Value of metallic production of Oregon in 1904, by counties.

County.	Gold.		Silver.		Copper.		Lead.		Platinum.	Total value.
	Placer.	Quartz.	Placer.	Quartz.	Quantity.	Value.	Quantity.	Value.		
					Pounds.		*Pounds.*			
Baker	$51,855	$738,973	$4	$44,351	1,800	$232	8,121	$290		$835,705
Coos	2,650	1,078		6					$550	4,284
Crook	320	500		1,000						1,820
Curry	9,394								303	9,697
Douglas	8,818								39	8,857
Grant	22,355	59,925		29,417	4,710	590	500	20		[a] 112,372
Jackson	85,208	23,345	21	70						108,644
Josephine and Lane	144,062	229,608	10	375	263,000	34,190			520	408,765
Lincoln	540								500	1,040
Malheur	13,526	9,543		10						23,079
Wallowa	400									400
Wheeler	10,086		20							10,106
Total	349,214	1,062,972	55	75,229	269,510	35,012	8,621	310	1,912	[a] 1,524,769
Grand total		1,412,186		75,284		35,012		310	1,912	[a] 1,524,769

[a] Includes $65 worth of cobalt.

Source of gold and silver from deep mines in Oregon in 1904, by kinds of ore.

County.	Gold.			Silver.		
	Siliceous ores.	Copper ores.	Total.	Siliceous ores.	Copper ores.	Total.
Baker	$738,943	$30	$738,973	$37,078	$6,273	$43,351
Coos	1,078	....	1,078	6	....	6
Crook	500	....	500	1,000	....	1,000
Grant	59,203	722	59,925	29,324	93	29,417
Jackson	23,345	....	23,345	70	....	70
Josephine and Lane	223,614	5,994	229,608	85	290	375
Malheur	9,543	....	9,543	10	....	10
Total	1,056,226	6,746	1,062,972	67,573	6,656	74,229

SOUTH DAKOTA.

By E. P. Porter.

PRODUCTION.

The production of gold in South Dakota in 1904 amounts to $7,363,977 and that of silver to $92,522.

The gold output in the Black Hills in 1904 almost reached the banner production of $7,500,000 in 1902, and this notwithstanding the adverse fact that the Golden Reward smelter, which in 1902 produced approximately $1,500,000, was closed down in 1904. This is to be credited to the new mills erected during the last two years and shows that substantial growth has taken place during that period. The Golden Reward Company is expected to have its smelter running early in the spring of 1905, and this, coupled with the numerous new plants projected and, with the increase of capacity in view at some of the plants now in operation, may result in a still greater production in 1905.

Several undertakings of great importance to the mining industry are now under way. One is the organization of the Consolidated Light and Power Company, which has taken over the properties of the Deadwood and Lead City electric companies and is planning the early erection of a 5,000-horsepower plant for the supplying of power and light to many of the mines and mills in the northern Black Hills. The average price for 1 horsepower per annum at the mines now is given as about $175.

A second undertaking which will further the development of a hitherto rather neglected region is the construction of the Missouri River and Northwestern Railroad from Mystic, on the Burlington Line, to Rapid City, on the Northwestern Road, a distance of 35 miles. The route is up the Circle Creek Valley to the Rapid Creek Valley, thence along Rapid Creek to Rapid City. The line will traverse a richly mineralized section, as well as a region abounding in sufficient timber for mine and fuel purposes for some time to come.

Increased capacity in the older mills will result in facilities for treating something like 46,000 tons of ore monthly. This increase in tonnage should raise the value of output at least $230,000 per month. There is one mill in the Galena district being built by the Branch Mint Mining Company which will have a monthly tonnage of 27,000 tons. This will be the largest cyanide plant in the Black Hills in which the ore is crushed directly from the mine. This mill will have 180 stamps and will be able to crush about 730 tons of ore a day.

At nearly all the cyanide plants, including the Homestake, experiments are under way which it is hoped will result in cheapening the present expense of gold extraction by cyanidation. At the Homestake, Superintendent Merrill, in charge of the cyanide department, is conducting experiments for the recovery of the values in the slimes, which now amount to 90 cents per ton. The present total recovery by amalgamation and cyanidation at the Homestake plants is given as nearly 90 per cent.

The output of ore for October was the largest of any month in the year. The gross output amounted to about $800,000, the Homestake, of course, leading. The Horseshoe Company stands next to the Homestake; the third company is the Golden Reward.

Cyanidation has been actively developed in South Dakota. Eleven cyanide plants have been in continuous operation; 9 of these have operated on refractory siliceous ore and 2 on Homestake ore. The 2 Homestake tailing plants have been enlarged, and now treat approximately 2,800 to 3,000 tons of sand per day. The recovery of bullion by cyanidation was about $2,541,737 in a total production of $7,363,977 for the year.

The annual production of the Black Hills has been growing rapidly, and judging from the rate at which new capital is seeking investment in the mines, this increase is likely to be maintained. Moreover, the enlargement of operating plants and the improvement in metallurgical processes are helping the older mines.

The following tables show the daily ore tonnage of various gold mines and reduction plants, either operating, idle, or contemplated:

Daily ore tonnage of gold mines and reduction plants in South Dakota in 1904, by name.

MINES PRODUCING REGULARLY IN 1904.

Name.	Daily tonnage.	Name.	Daily tonnage.
Alexander Maitland	150	Imperial	125
Clover Leaf	240	Lundberg, Door & Wilson	100
Dakota	120	Spearfish	250
Golden Reward Cyanide	200	Wasp No. 2	125
Hidden Fortune	120		
Homestake	4,000	Total	5,730
Horseshoe	300		

Daily ore tonnage of gold mines and reduction plants in South Dakota in 1904, etc.—Cont'd.

MINES PRODUCING INTERMITTENTLY IN 1904.

Name.	Daily tonnage.	Name.	Daily tonnage.
Black Eagle	20	National Smelter	150
Clara Belle	10	Puritan	100
Cochran	20	Rossiter	100
Columbus Consolidated	75	Tinton	100
Extreme	40	Total	735
Golden Crest	40		
Lexington Hill	80		

REDUCTION PLANTS NOT IN USE IN 1904.

Alder Creek	120	Jupiter	125
Continental Smelter	80	Mainstay	125
Commonwealth	40	Pluma	160
Deadwood Standard	125	Ruby	40
Golden Slipper	20	Tycoon	40
Golden Reward Smelter	300	Total	1,275
Holy Terror	100		

REDUCTION PLANTS PUT IN COMMISSION IN 1904.

Black Eagle	60	Lundberg, Door & Wilson	100
Gilt-edge Maid	150	Rossiter	100
Golden Crest	50	Underwood	10
Homestake (increase)	400	Total	1,340
Hidden Fortune	120		
Horseshoe	350		

MILLS ON WHICH CONSTRUCTION WAS COMMENCED IN 1904.

Branch Mint	900	Puritan	100
Canton	80	Queen of the Hills	100
Eleventh Hour	150	Ruby	40
Globe	130	Sunbeam	40
Golden West	150	Victor	100
Lucky Strike	25	Total	1,915
Ohio Deadwood	100		

MILLS CONTEMPLATED IN 1904.

Aurizone	100	Iron Creek	100
Bullion	200	Lucky Strike	250
Big Lead	200	Reliance	300
Bryant	100	Ruberta	20
Black Hills Anaconda	50	Safe Investment	250
Custer Peak	10	Saginaw	100
Commonwealth	100	Victoria	200
Capitol City	150	Total	4,425
Columbus Consolidated	1,000		
Deer Lick	100	Black Hills Electric Power and Mining Company (hydraulic) ..cubic yards..	2,000
Golden Eagle	80	L. A. Richards (hydraulic) ....do....	1,500
Golden Empire (electric dredges)	1,000	Total ....do....	3,500
Homestake Extension	100		
Ivanhoe	15		

Daily ore tonnage of gold mines and reduction plants in South Dakota in 1904, etc.—Cont'd.

MILLS TO INCREASE PRESENT TONNAGE OF PLANT.

Name.	Present capacity.	Additional capacity.	Total tonnage.
Clara Belle	25	75	100
Dorr	100	100	200
Hidden Fortune	120	180	300
Horseshoe	350	150	500
Imperial	130	70	200
Lexington Hill	60	240	300
Puritan	40	40	80
Tinton	100	150	250
Wasp No. 2	115	50	165
Extreme	40	40	80

Among the prominent companies which have installed, or are preparing to install, machinery for development purposes are Eliptic, Dizzy, Goldstake, Lucky Strike, Puritan, Big Four, Hidden Treasure, Dakota, Horseshoe, Black Eagle, Grand, Deadwood Standard, Queen of the Hills, Gopher, Main Stay, Ivanhoe, Red Bird, Lakota, Rex, Safe Investment, Canton, Extreme, Empire State, Anaconda, Commonwealth, Custer Peak, Iron Creek, Minnesota, Omaha, Alexander Maitland, Pittsburg, Waconda, American, and Sunbeam.

The following tables show the production and distribution of gold and silver in South Dakota in 1904, by counties, by sources, by method of treatment, etc.:

Distribution of gold and silver in South Dakota in 1904, by counties.

[Fine ounces.]

County.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
Custer	314.03	$6,491	121	$69
Lawrence	355,441.99	7,346,986	161,216	92,296
Pennington	507.98	10,500	274	157
Total	356,264.00	7,363,977	161,611	92,522

Value of production of gold and silver in South Dakota in 1904, by kinds of ore and by counties.

County.	Gold.		Silver.		
	Quartz ores.	Placers.	Quartz ores.	Lead ores.	Copper ores.
Custer	$5,845	$646	$69	....	....
Lawrence	7,344,842	2,144	91,107	$739	$450
Pennington	9,676	824	157	....	....
Total	7,360,363	3,614	91,333	739	450

Value of production of gold and silver in South Dakota in 1904, by methods of treatment and by counties.

County.	Placer.	Cyanide.	Amalgamation.	Smelting.	Total.
Custer	$646	....	$5,384	$530	$6,560
Lawrence	2,144	$2,541,737	4,761,240	134,161	7,439,282
Pennington	824	....	9,420	413	10,657
Total	3,614	2,541,737	4,776,044	135,104	7,456,499

Gold and silver production in South Dakota in 1904, by mines, by methods of treatment and by counties.

County.	Gold: Surface or placer mines.		Gold and silver: Deep mines.				
			By milling.		By smelting.		
	Sluicing.	Drifting.	Amalgamation.	Cyanide.	Siliceous.	Lead ores.	Copper ores.
Custer	$646	....	$5,384	....	$530	....	....
Lawrence	2,144	....	4,761,241	$2,541,104	130,401	$942	$3,450
Pennington	426	$398	9,300	....	120	413	....
Total	3,216	398	4,775,925	2,541,104	131,051	1,355	3,450

Statement of tonnage of gold ores treated in South Dakota in 1904, by methods and by counties.

County.	By milling.				By smelting.			
	Number of mines.	Tons crushed.	Total value.	Value per ton.	Number of mines.	Tons crushed.	Total value.	Value per ton.
Custer	1	1,900	$5,845	$3.08	....	....	....	....
Lawrence	23	1,790,600	7,302,345	4.08	15	10,924	$134,793	$12.34
Pennington	8	1,441	9,300	6.45	2	70	533	7.61
Total	32	1,793,941	7,317,490	4.08	17	10,994	135,326	12.31

Production of gold and silver in South Dakota from deep mines in 1903 and 1904, by counties.

County.	1903.				1904.				
	Number of mines.	Tons of ore crushed.	Gold.	Silver.	Number of mines.	Tons of ore crushed.	Gold.	Silver.	Total.
Custer	3	23	$163	$3	1	1,900	$5,845	$69	$5,914
Lawrence	29	1,670,215	6,791,852	119,445	37	1,801,524	7,344,842	92,296	7,437,138
Pennington	3	5,816	24,803	....	10	1,511	9,676	157	9,833
Total	35	1,676,054	6,816,818	119,448	48	1,804,935	7,360,363	92,522	7,452,885

Distribution of gold and silver in South Dakota in 1904 as to tonnage and treatment, by counties.

County.	Placer.	Tons of ore mined.	Shipped to smelter.		Milled.	
			Tons crushed.	Value.	Tons.	Value.
Custer	$646	3,965	....	....	1,900	$5,384
Lawrence	2,144	1,817,046	10,924	$133,472	1,790,600	6,408,241
Pennington	824	6,079	70	533	1,441	9,300
Total	3,614	1,827,090	10,994	134,005	1,793,941	6,422,925

County.	Concentrates shipped.		Tailings cyanided.		Total.
	Tons.	Value.	Tons.	Value.	
Custer	20	$530	....	....	$6,560
Lawrence	17	689	400,900	$894,736	7,439,282
Pennington	......	....	....	....	10,657
Total	37	1,219	400,900	894,736	7,456,499

Production of gold and silver in South Dakota in 1904, by counties.

[Fine ounces.]

County.	Tons of ore treated.	Gold.			Number of gold mines producing—	
		Quantity.	Value.	Value per ton.	Copper.	Lead.
Custer	1,900	283	$5,845	$3.08	....	....
Lawrence	1,801,049	355,387	7,344,842	4.08	....	1
Pennington	1,511	468	9,676	6.40	....	1
Total	1,804,460	356,138	7,360,363	4.08	....	2

County.	Tons of ore treated.	Silver.			Number of silver mines producing—	
		Quantity.	Value.	Value per ton.	Copper.	Lead.
Custer	1,900	121	$69	$0.04	....	....
Lawrence	1,693,248	161,216	92,296	.05	1	2
Pennington	706	274	157	.22	....	....
Total	1,695,854	161,611	92,522	.05	1	2

UTAH.

By V. C. Heikes.

PRODUCTION.

The production of gold and silver in Utah during the year 1904 was, gold 202,675 ounces, of the value of $4,189,292, and silver 12,049,446 ounces, of the commercial value of $6,898,408.

The statement of production compared with last year is as follows:

Production of gold and silver in Utah in 1903 and 1904.

[Fine ounces.]

	1903.		1904.		Increase (+) or decrease (−).
	Quantity.	Value.	Quantity.	Value.	
Gold	210,162	$4,344,069	202,675	$4,189,292	−$154,777
Silver	12,204,011	[a] 6,518,151	12,049,446	[b] 6,898,308	+ 380,157
Total		10,862,220		11,087,600	+ 225,380

[a] Commercial value, 53.41 cents per ounce.
[b] Commercial value, 57.25 cents per ounce.

The gold product shows a decrease of 7,487 ounces, valued at $154,777; the silver product shows a decrease in quantity of 154,565 ounces, but on account of higher price paid in 1904 for the metal per ounce the value increased $380,146, making a total increase for both metals of $225,369. This loss in annual production may be attributed chiefly to the idleness of the mines at Stateline, in Iron County; to the decreased shipments of several properties at Park City, in Summit and Wasatch counties; and to the decreased output of ores in the Camp Floyd district, Tooele County.

Although the precious metals output of Utah for the year 1904 shows as to the gross value of gold a decrease from the preceding year, an analysis of the reports returned from producers for the whole State indicates that this decrease has not been general or equal in the various districts. The districts showing an increased yield named in the order of precedence were West Mountain mining district (Bingham), in Salt Lake County, and Tintic mining district, in Juab County.

The tonnage of ore actually being mined in the State has, perhaps, a more direct bearing upon the general business prosperity of the local community than have the values produced, inasmuch as the ore represents the amount of work actually taking place, and in this respect the year 1904 shows a very greatly increased output of ore, amounting to 1,716,947 tons, an increase over the preceding year of 304,568 tons, or 22 per cent.

The gross quantity and value of the principal metals, besides gold and silver, produced in Utah for the year 1904, reported by mining operators and figured at the average commercial price for the year, was: Copper, 46,417,234 pounds, $5,802,154; lead, 116,479,764 pounds, $5,095,989; zinc and mercury, $79,688. The total value of the four principal metals, with zinc and mercury included, was $22,065,431, an increase for the year of $2,345,013, as is shown in the following table:

Metallic production of Utah in 1903 and 1904.

	1903.		1904.		Increase (+) or decrease (−) in quantity.
	Quantity.	Value.	Quantity.	Value.	
Gold .... ounces..	210,162	$4,344,069	202,675	$4,189,292	− 7,487
Silver .... do....	12,204,011	6,518,162	12,049,446	6,898,308	− 154,565
Copper .... pounds..	32,847,656	4,542,831	46,417,234	5,802,154	+13,569,578
Lead .... do....	100,742,633	4,311,785	116,479,764	5,095,989	+15,737,131
Other metals	....	3,571	....	79,688	....
Total	....	19,720,418	....	22,065,431	....

The total quantity of ore sold or treated in Utah for each of the last three years is shown by the following figures:

Total tons of ore sold or treated in Utah in 1902, 1903, and 1904.

	Short tons.
1902	1,114,785
1903	1,412,379
1904	1,716,947

In the table below is shown the production of the metal-producing counties of Utah by quantities of gold, silver, copper, and lead for the years 1903 and 1904:

Total quantities of metals produced in Utah in 1903 and 1904, by counties.[a]

County.	Gold.		Silver.		Copper.		Lead.	
	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.
	Fine ounces.	*Fine ounces.*	*Fine ounces.*	*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Beaver and Piute	23,636	19,085	183,548	179,771	432,409	1,650,787	5,505,694	7,555,650
Juab and Utah........	66,009	72,767	3,622,596	4,048,442	8,023,464	9,035,720	12,496,900	23,392,398
Salt Lake	43,555	56,698	969,849	1,554,609	18,604,989	30,864,666	1,654,082	6,394,388
Summit and Wasatch .	15,317	13,643	7,109,209	5,814,386	3,297,101	2,118,452	78,243,720	64,312,559
Tooele	56,559	36,757	263,682	418,584	984,295	1,023,825	2,832,237	14,774,769
Washington, Millard, Sevier, Grand, and Boxelder........	5,086	3,725	55,127	33,654	1,505,398	1,723,784	10,000	50,000
Total........	210,162	202,675	12,204,011	12,049,446	32,847,656	46,417,234	100,742,633	116,479,764

[a] In this table some counties have been grouped in order to prevent disclosure of the production by certain mining companies.

These figures show where to place the decrease of the metals by counties for the two years 1903 and 1904.

The following table shows the tonnage output of the counties; also the number of mines selling or treating over 100 tons of ore, and the total value of gold and silver contents of the ore for 1903 and 1904:

Tonnage output of Utah in 1903 and 1904 by counties.

County.	Total tons of ore sold or treated.		Number of mines producing over 100 tons of ore.		Total value gold and silver contents.	
	1903.	1904.	1903.	1904.	1903.	1904.
Beaver, Iron, and Piute	76,795	[a] 76,647	3	4	$586,589	$497,406
Juab and Utah	190,596	264,448	20	27	3,299,234	3,821,827
Salt Lake	532,503	710,670	14	17	1,418,278	2,061,961
Summit and Wasatch	197,429	250,047	5	13	4,113,631	3,610,737
Tooele	386,130	396,250	6	12	1,309,908	999,406
Washington, Millard, Sevier, Grand, and Boxelder	28,926	18,885	5	4	134,591	96,263
Total	1,412,379	1,716,947	53	77	10,862,231	11,087,600

[a] No production in Iron County.

To say that the increase in tonnage was made chiefly by the West Mountain (Bingham) and Tintic districts scarcely does these districts full justice, for not only have they made the increase shown, but they have also offset decreases in certain districts of other counties.

The ores of a mine are classified in this section as siliceous ores, ores cyanided, lead ores, and copper ores. Siliceous ores and ores cyanided may be classed under one heading as quartz. The tables following are arranged for comparing the yearly output and showing the origin of precious metal contained in the siliceous ores going to the smelter or extracted by amalgamation. The method also serves to show the amount of precious metals treated by cyanide process. The lead and copper ores are classified according to the excess in quantity in either element with which gold and silver are associated.

The gold yield from different kinds of Utah ores in 1903 and 1904 was as follows:

Production of gold in Utah in 1903 and 1904, by kinds of ore.

[Fine ounces.]

Year.	Siliceous ores.	Ores cyanided.	Lead ores.	Copper ores.	Total.
1903	5,884	79,165	33,035	92,078	210,162
1904	4,017	54,730	33,894	109,968	202,609

The decrease in gold contained in siliceous ores was due to diminished operations in Iron and Boxelder counties. The output of ores treated by cyanide in Tooele County fell short of the usual production, yet the average yield of these ores has been maintained and very likely will increase hereafter. The lead ores of Juab and Salt Lake counties continue to increase in gold. The most striking feature in connection with the gold production in Utah is the increased output of the metal from the auriferous copper ores of Bingham in the West Mountain district of Salt Lake County, there being an increase from this source of 12,618 ounces over the production of 1903. In fact, the increase of gold from this source did much to make up for the deficiency in other classes of mines in 1904. Some of the smelting ores of Tintic district, in Juab County, containing copper and lead helped to increase the gold output in 1904 for that county.

From placers on the Colorado and Grand rivers 65.5 ounces of gold were produced. Reports of activity in placer mining from several localities in Utah indicate that the gold from this source will increase during 1905.

Silver from siliceous ores, from other ores treated by cyanide, and from lead and copper ores is given as follows:

Production of silver in Utah in 1903 and 1904, by kinds of ores.

[Fine ounces.]

Year.	Siliceous ores.	Ores cyanided.	Lead ores.	Copper ores.	Total.
1903	56,631	116,141	9,317,074	2,714,165	12,204,011
1904	90,486	67,878	9,318,500	2,572,582	12,049,446

The silver contained in siliceous ores is to be credited to Boxelder, Piute, and Washington counties. In ores cyanided Piute County is the heaviest producer. The silver originating in the lead ores was contained in the shipments of this product from Juab, Salt Lake, and Tooele counties. The principal districts contributing were Tintic, Park City, and Stockton. Considerable quantities of the argentiferous lead ore came from Frisco, in Beaver County, and Bingham, in Salt Lake County. The silver won from copper ores was contained in the product of the Bingham mines and of the Tintic district.

The gold production for 1903 and 1904, distributed by counties, for the State of Utah is shown below:

Production of gold in Utah in 1903 and 1904, by counties.

[Fine ounces.]

County.	1903.		1904.		Increase (+) or decrease (−) in quantity.
	Quantity.	Value.	Quantity.	Value.	
Beaver, Iron, and Piute	23,636	$488,556	19,085	$394,487	− 4,551
Juab and Utah	66,009	1,364,406	72,767	1,504,094	+ 6,758
Salt Lake	43,555	900,282	56,698	1,171,947	+13,143
Summit and Wasatch	15,317	316,602	13,643	282,001	− 1,674
Tooele	56,559	1,169,075	36,757	759,767	−19,802
Washington, Millard, Sevier, Grand, and Boxelder	5,086	105,148	3,725	76,996	− 1,361

Salt Lake County had the heaviest increase because of more active operations and greater tonnage of ore from several of the largest properties in the Bingham district of Salt Lake County, Juab County following with a like credit to Tintic for a like reason. Iron County dropped out of the line of producers entirely. Summit and Tooele counties also showed a decrease.

The production of silver during the year 1904 when compared with the corresponding figures for 1903 shows the following results:

Production of silver in Utah in 1903 and 1904, by counties.

[Fine ounces.]

County.	1903.		1904.		Increase (+) or decrease (−) in quantity.
	Quantity.	Value.	Quantity.	Value.	
Beaver, Iron, and Piute	183,548	$98,033	179,771	$102,919	− 3,777
Juab and Utah	3,622,596	1,934,828	4,048,442	2,317,733	+ 425,846
Salt Lake	969,849	517,996	1,554,609	890,014	+ 584,760
Summit and Wasatch	7,109,209	3,797,029	5,814,386	3,328,736	−1,294,823
Tooele	263,682	140,833	418,584	239,639	+ 154,902
Washington, Millard, Sevier, Grand, and Boxelder	55,127	29,443	33,654	19,267	− 21,473

The commercial value of silver per ounce in 1903 was 53.41 cents; in 1904 it was 57.25 cents.

The greatest increase in silver was made in Salt Lake County, Juab and Tooele counties following.

The reports returned from mining operations in Utah in 1904 numbered 716. Of this number, 594 lode mines and 10 placers reported development and assessment work; the remainder, 112 in number, were producing properties. Of these 110 were quartz or lode mines and 2 placer mines. In addition, 45 milling and 7 smelting plants were reported. Of the milling plants connected with mines, 26 were operating, 17 were idle, and 2 had been dismantled. Of the 7 smelters, 3 were connected with mines; the other 4, each treating ores from properties connected with the same organization, are located near Salt Lake City. Custom ores were purchased by 2 of the smelting companies.

Of the 26 milling plants, 4 were stamp mills in which the ore was concentrated, which was followed by amalgamation. One mill was equipped with direct amalgamation over copper plates. Fourteen mills were equipped with different kinds of crushers, rolls, and concentrators. Seven were plants using the cyanide process, of which plants 5 cyanided the ore without other treatment; 1 combined amalgamation for coarse gold with crushing in cyanide solution and passing the pulp over silver-coated copper plates to concentrators, and with final treatment of tailings in cyanide solution, and one dry crushed, cyanided, and amalgamated.

ORES SMELTED.

The mine operators in making up the reports for the Geological Survey very frequently gave the net amount paid for the contents of the ores at the smelters. When quantities were given, only the average commercial price for the year was used in figuring the total. Accordingly, for ores and concentrates shipped to smelters during 1904, the gold value is found to average $19.80 per ounce; silver, 57.02 cents per ounce; copper, 10.50 cents per pound, and lead 3.60 cents per pound. Ores shipped and treated at smelters during 1904 from Utah mines amounted to 925,365 tons; for the gold, silver, copper, lead, and zinc contents of which $15,585,452 was paid, an average value of $16.84 per ton.

CONCENTRATED ORES.

From 769,451 tons of milling ore 76,908 tons of concentrates were produced from the reduction plants at mines and shipped to smelters, which paid the sum of $3,208,654, or an average of $41.72 per ton for the gold, silver, copper, and lead contents. Gold and silver bullion was produced, valued at $1,261,410, which came more directly from 392,709 tons of ore, an average of $3.21 per ton. There were also produced 58,981 pounds of mercury, valued at $32,093. Old tailings were treated, amounting to 22,040 tons, valued at $53,490, which is included in the value of the gold and silver bullion produced.

WASHINGTON.

By Charles G. Yale.

PRODUCTION.

According to returns received from Washington that State had a yield of $314,463 in gold, $89,831 in silver, $69,937 in lead, $43,788 in copper, and $9 in platinum, a total of $518,028.

The returns received indicate a decrease in gold production from that of the year 1903 of $193,422, occasioned by the idleness of several large mines in Chelan, Ferry, Okanogan, and Snohomish counties, Ferry County showing a decrease of over $162,000, Chelan of over $60,000, Okanogan of over $15,000, and Snohomish of over $43,000. King County shows a small increase, and Whatcom County production increased from $36,388 to $115,000.

The silver product shows a decrease of $111,958, Ferry County showing a decrease of over $61,000, Okanogan of $14,000, Snohomish of $22,000, and Stevens of $14,775. The total decrease for the year of combined gold and silver was $305,380.

The gold and silver comes almost entirely from quartz mines, the total placer gold recovered only amounting to $9,823 from Asotin, Clark, Kittitas, and Whatcom counties, the placers in Okanogan County being idle in 1904.

As in 1903 Ferry County was the largest gold producer from deep mines, Whatcom County was a close second in 1904. Stevens County was the largest silver producer.

In gold production the rank of the counties is as follows: Ferry, Whatcom, Snohomish, Chelan, Okanogan, Stevens, King, Kittitas, Clark, Asotin. The rank in silver production is Stevens, Ferry, Whatcom, Snohomish, Okanogan. Stevens County produced the most copper and lead, and Clark County reports $9 in platinum.

Lack of transportation and the fact that nearly all ore requires smelting account for the relatively few producing mines; a very large proportion of the known properties in the State are in the development stage and 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 inquires.

Producing and nonproducing mines in Washington in 1904, by counties.

County.	Producing mines.		Development or assessment mines.	
	Quartz.	Placer.	Quartz.	Placer.
Asotin		2	9	
Chelan	1		42	
Clark	1	3		
Cowlitz			4	
Ferry	7		57	
King	2		33	
Kittitas	3	3	38	3
Lewis			3	
Lincoln			16	
Okanogan	5		112	
Pierce			4	
Skamania			3	
Skagit			11	
Snohomish	5		98	
Stevens	18		79	
Whatcom	3	1	41	
Total	45	9	550	3

Many of the former producing mines were idle in 1904, especially at Republic, but new properties, more particularly gold-bearing ones, were being developed, and it is likely that the State production of gold and silver will show substantial increases in 1905.

Source of gold and silver from deep mines in Washington in 1904, by counties.

County.	Gold.				Silver.			
	Siliceous ores.	Copper ores.	Lead ores.	Total.	Siliceous ores.	Copper ores.	Lead ores.	Total.
Chelan	$20,000			$20,000				
Clark	100			100				
Ferry	108,257	$5,000		113,257	$17,085	$5,000		$22,085
King	6,327			6,327				
Kittitas	1,907	32		1,939				
Okanogan	18,066			18,066	6,152			6,152
Snohomish	20,384	5,967		26,351	4,719	2,414		7,133
Stevens	10,579	1,021		11,600	9,952	2,111	$28,027	40,090
Whatcom	107,000			107,000	14,371			14,371
Total	292,620	12,020		304,640	52,279	9,525	28,027	89,831

Value of metallic production of Washington, 1904, by counties.

[Pounds.]

County.	Gold.		Silver.	Copper.		Lead.		Platinum.	Total value.
	Placer.	Deep.		Quantity.	Value.	Quantity.	Value.		
Asotin, Chelan, Clark	$1,087	$20,100						$9	$21,196
Ferry		113,257	$22,085	77,548	$8,948				144,290
King		6,327							6,327
Kittitas	736	1,939		329	46				2,721
Okanogan		18,066	6,152						24,218
Snohomish		26,351	7,133	77,850	8,991				42,475
Stevens		11,600	40,090	194,320	25,803	1,760,309	$69,937		147,430
Whatcom	8,000	107,000	14,371						129,371
Total	9,823	304,640	89,831	350,047	43,788	1,760,309	69,937	9	518,028

WYOMING.

By E. P. Porter.

PRODUCTION.

The production of gold and silver in Wyoming in 1904, as reported by the owners and different companies, was: Gold, $17,305, and silver, $2,661, a total of $19,966. The value of silver is computed from the American Refining and Smelting Company's average for the year 1904, which is $0.5725 per ounce.

Copper was produced to the value of $440,876, computed at the average price per pound of $0.125.

Wyoming increased in production in all three of the metals mentioned, especially in copper, the output of which very nearly equaled that of the banner year for copper, which was 1900. This increase was caused largely by the production at the Ferris-Haggerty mine, located at Encampment, Wyo.

The following tables show the production and distribution of gold and silver in Wyoming in 1904, by counties, by mines, by method of treatment, etc.:

Production of gold and silver in Wyoming in 1904, by counties.

[Fine ounces.]

County.	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
Albany and Carbon	325	$6,746	4,603	$2,636
Cook, Fremont, and Johnson	511	10,559	44	25
Total	837	17,305	4,647	2,651

Value of gold and silver production of Wyoming in 1904, by method of treatment and by counties.

County.	Gold from surface or placer mines.		Gold produced from ore.		Silver produced from ore.	
	Sluicing.	Drifting.	By milling-amalgamation.	By smelting of copper ore.	By milling.	By smelting of copper ore.
Albany and Carbon	....	....	....	$6,746	....	$2,636
Cook, Fremont, and Johnson	$2,031	$200	$8,328	....	$25	....

Tonnage of gold and silver ores in Wyoming in 1904, by counties.

[Fine ounces.]

County.	Gold.			Silver.		
	Tons of ore treated.	Quantity.	Value.	Tons of ore treated.	Quantity.	Value.
Albany and Carbon	41,390	326	$6,746	41,402	4,603	$2,631
Crook, Fremont, and Johnson	704	403	8,328	2	44	25
Total	42,094	729	15,074	41,404	4,647	2,656

The gold production of 1904 came principally from Crook and Fremont counties, the output of the former being directly from placers near Welcome, Wyo. Associated with these placers, considerable stream tin is found, although it is not ordinarily saved.

Five counties, namely, Albany, Carbon, Crook, Fremont, and Johnson, produced gold in small quantities, which in most cases was the result of test runs.

Among the recent discoveries of gold in Wyoming that at McCormick Peak, near Dillon, Carbon County, bids fair to be important. An important strike of high-grade copper ore was also reported in the Doane-Rambler mine in the Grand Encampment district. The rumored extension of the Laramie and Hahns Peak Railroad now building from Laramie has resulted in the resumption of work on a number of properties in the vicinity of Centennial. Operations in the Medicine Bow region, in Albany County, have been of an encouraging nature, and there is some talk of the erection of a reduction plant on the properties of the Medicine Bow Mines Company.

COPPER.

By Charles Kirchhoff.

GENERAL TRADE CONDITIONS.

A comparatively high level of prices, an enormous production, and an unprecedented export demand were the characteristic features of the copper trade in 1904. The industry has been exceptionally prosperous and has displayed an activity which promises a further notable addition to production during the year 1905. Undertakings begun in 1904 will only bear fruit in 1905, and some developments will not add to output until well into 1906. Improvements in mining, concentrating, and smelting are making available to an increasing extent very extensive bodies of low-grade ores, and are rendering the copper industry less dependent upon the discovery and the life of individual rich deposits. The development and operation of low-grade properties, however, calls for relatively very large capital investments. The unit of maximum efficiency of plants is growing and tends to an increasing concentration of interests.

Broadly, the features were an increase in the production of copper in the United States of 114,492,750 pounds, from 698,044,517 pounds in 1903 to 812,537,267 pounds in 1904, and an increase in the net exports of 231,638,043 pounds, from 151,614,632 pounds in 1903 to 383,252,675 pounds in 1904. In other words, the enormous export trade absorbed not alone the increase in production, but 117,145,293 pounds additional. Our domestic consumption, however, fell off in 1904 as compared with 1903, so that instead of drawing upon our stocks to the extent of the whole 117,000,000 pounds we drew upon them only to the extent of about 56,000,000 pounds.

The detailed study of the industry in the leading districts, which is presented in the following pages, shows that a considerable increase in the production of copper will take place in 1905, unless some disturbance or catastrophe causes a general or partial cessation of work.

It is difficult to estimate the quantity for the year, even assuming that normal conditions will prevail, because the new producers swing into line from time to time, usually at a belated date, and at a rate below the tonnage aimed at. The enlargements of old producers are subject to similar delays. But making full allowance for such causes, there is reason to believe that the production of 1905 will be larger by at least 75,000,000 pounds than that of 1904, and that possibly a production of 900,000,000 pounds may be reached.

The largest contributor to the additional product will be Arizona, with the Bisbee district leading. Utah, the Butte district, and the Lake district will follow, and California, Alaska, Wyoming, and the South will each contribute materially.

The consumption during the second half of 1904 developed on an enormous scale the world over, and the great requirements of the electrical industry and of the Russo-Japanese war are factors which must tell for a considerable time to come, the first named being of the greatest importance. A somewhat puzzling development has been the very large demand from China, which can not well be fully explained by the withdrawal of working forces from the Japanese mines, the usual source of supply, nor by the coinage requirements. It is widely believed that a considerable part of the purchases is on speculative account for Chinese merchants, whose accumulations will in any case flow slowly back into the channels of consumption.

PRODUCTION.

The following tables show 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, 1845–1882.

[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
1881	32,000	24,363	76.1
1882	40,467	25,439	62.9

Production of copper in the United States, 1883–1904, official statistics.

[Long tons.]

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.
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
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
1904	362,739	92,995	25.6	133,168	36.7	85,537	23.6

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, 1893–1904, by States.

[Pounds.]

Source.	1893.	1894.	1895.	1896.	1897.
Lake Superior	112,605,078	114,308,870	129,330,749	143,524,069	145,282,059
Arizona	43,902,824	44,514,894	47,953,553	72,934,927	81,530,735
Montana	155,209,133	183,072,756	190,172,150	221,918,179	230,288,141
New Mexico	280,742	31,884	143,719	2,701,664	701,892
California	239,682	120,000	218,332	690,237	11,987,772
Utah	1,135,330	1,147,570	2,184,708	3,502,012	3,919,010
Colorado, including copper smelters [a]	7,695,826	6,481,413	6,079,243	6,022,176	11,873,033
Nevada	20,000	....	....	....	....
Idaho	36,367	....	1,425,914	....	183,277
South Dakota	....	....	....	....	2,440,338
Washington	39,785	....	....	....	....
Maine and New Hampshire, Vermont, Tennessee and Southern States, Middle States	732,793	2,374,514	3,105,036	4,704,993	4,472,017
Lead desilverizers, etc. [b]	7,456,838	2,136,473	....	4,063,173	1,400,000
Total domestic copper	329,354,398	354,188,374	380,613,404	460,061,430	494,078,274
From imported pyrites and ores and matte	10,431,574	10,678,434	[c] 5,300,000	[c] 5,900,000	[c] 12,000,000
Total (including copper from imported pyrites)	339,785,972	364,866,808	385,913,404	465,961,430	506,078,274

[a] Copper smelters in Colorado, purchasing argentiferous copper ores and mattes in the open market, sources not known. The quantity of Montana matte which goes to one of these works has been deducted.
[b] For 1896 the quantity stated covers only that part of the incidental copper product the source of which could not be ascertained.
[c] Estimated.

Total copper production in the United States, 1893–1904—Continued.

[Pounds.]

Source.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Lake Superior	158,491,703	147,400,338	145,461,498	156,289,481	170,609,228	192,400,577	208,309,130
Arizona	111,158,246	133,054,860	118,317,764	130,778,611	119,944,944	147,648,271	191,602,958
Montana	206,173,157	225,126,855	270,738,489	229,870,415	288,903,820	272,555,854	298,314,804
New Mexico	1,592,371	3,935,441	4,169,400	9,629,884	6,614,961	7,300,832	5,368,666
California	16,925,634	26,221,897	28,511,225	33,667,456	25,038,724	17,776,756	28,529,023
Utah	3,750,000	9,584,746	18,354,726	20,116,979	23,939,901	38,302,602	47,062,889
Colorado, including copper smelters [a]	16,274,561	11,643,608	7,826,949	9,801,783	8,422,030	4,158,368	9,506,944
Alaska	....	....	....	....	....	1,339,590	2,043,586
Wyoming	233,044	3,104,827	4,203,776	2,698,712	889,228	1,023,189	3,565,629
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	2,158,858
South Dakota	1,261,393	17,020	15,147	753,510	445,663	173,202	100,000
Washington	....	....	....	....	209,297	80,758	663,694
Maine and New Hampshire; Vermont; Tennessee and Southern States; Middle States	5,395,226	4,410,554	4,820,495	6,860,039	13,599,047	13,855,612	15,211,086
Lead desilverizers, etc. [b]	3,553,336	3,500,000	3,000,000	531,530	500,000	500,000	100,000
Total domestic copper	526,512,987	568,666,921	606,117,166	602,072,519	659,508,644	698,044,517	812,537,267
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	38,947,772
Total (including copper from imported pyrites)	546,262,987	592,466,921	642,497,166	666,072,519	699,508,644	730,044,517	851,485,039

[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 1898, 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, 1898–1904.

[Pounds.]

Mine.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Tamarack	19,660,480	18,565,602	19,181,605	18,000,852	15,961,528	15,286,093	14,961,885
Quincy	16,354,061	14,301,182	14,116,551	20,540,720	18,988,691	18,498,288	18,343,160
Osceola	12,682,297	11,358,049	12,567,131	13,723,487	13,416,396	16,059,636	20,472,429
Franklin	2,623,702	1,230,000	3,663,710	3,757,419	5,259,140	5,309,030	4,771,050
Atlantic	4,377,399	4,675,882	4,930,149	4,666,889	4,949,366	5,505,598	5,321,859
Central	291,339						
Wolverine	4,588,114	4,756,646	4,778,829	4,946,126	6,473,181	9,024,034	9,764,655
Baltic	42,766	621,336	1,735,060	2,641,432	6,285,819	10,580,997	12,177,729
Champion					4,165,784	10,564,147	12,212,954
Trimountain					5,730,807	9,237,051	10,211,230
Isle Royale				2,171,955	3,569,748	3,134,601	2,442,905
Mohawk				677,145	908,479	6,284,327	8,149,515
Mass		42,800	122,239	873,297	2,345,805	2,576,447	2,182,931
Michigan					166,898	275,708	2,739,122
Winona					101,188	1,036,944	646,025
Phoenix				93,643		202,823	1,162,201
Adventure				29,361	606,211	2,182,608	1,380,480
Ahmeek							376,687
Centennial				806,400			641,294

Calumet and Hecla.—The annual report of the Calumet and Hecla Company for the year ending April 30, 1905, states that the company produced mineral equal to 43,090 short tons of refined copper, as against 41,612 tons during the preceding year. The product of refined copper was 42,822 tons and 38,305 tons, respectively. The increase in the product is attributed partly to the results obtained on the Osceola lode, the report stating that since July, 1904, about 75,000 tons of amygdaloid rock has been stamped, from which an extraction of 22 pounds of copper per ton of rock has been obtained. It is proposed to increase the product from this amygdaloid by openings from one or more shafts already opened on the lode. The quality of the ground passed through on the Kearsarge lode is pronounced promising.

The report makes the following statements in regard to the plants of the company:

At Lake Linden the remodeling of the Calumet mill has been completed; the mill is running most satisfactorily, and is making a marked saving of copper as compared with the results obtained with the old machinery. This gives us now 17 heads equipped with economical milling and washing machinery. We have started the remodeling of the Hecla mill and hope to have six additional heads running on the new system by May, 1906, leaving only five heads to be remodeled in the year 1906–7. At the Lake Linden smelting works an addition has been made to the machine shop; one blister furnace and three refining furnaces have been built. Since July we have smelted about 1,500 tons of mineral per month from the Mohawk, Wolverine, Atlantic, and Michigan mines, with excellent results as to the quality of copper produced. Excellent progress has been made in the erection of two large engines for driving the additions to our electric-power plant at Lake Linden. This power is to be used in part of the mill work, underground pumping, tramming, rock crushing, and to supersede our electric-light plant at the mine and many small air and steam engines now in use in the various shops, also for hoisting on the Osceola and Kearsarge vein. We expect to have this electric plant in commission about the first of November.

There has been purchased the timber on 42,000 acres of land in Keweenaw County.

Quincy.—The product of the Quincy Mining Company was slightly lower in 1904 than in 1903, although the tonnage stamped was somewhat larger, having been 1,018,873 short tons in 1904, as compared with 958,935 tons in 1903. The yield of copper per ton of rock fell from 19.3 pounds in 1903 to 18 pounds in 1904. In 1901 it was 23.2 pounds. The gross receipts were $2,444,749. The expenses at the mine were $1,594,711, the cost of smelting, etc., $194,110, and the outlays for construction $106,002, leaving a profit of $549,926. Other income added $27,630. Dividends aggregating $500,000 were paid.

An interesting experiment was tried at the Quincy stamp mill in the form of the installation of a set of rolls in connection with each head of stamps to crush the oversized gravel from the trommels instead of returning this material to the stamps. It is believed that this will greatly increase the capacity per head. A similar result is expected to follow the conversion of the simple stamps into steeple compound stamps, which are being introduced into a number of the Lake Superior copper stamp mills.

Tamarack.—The product of the Tamarack Mining Company was slightly smaller in 1904 than it was in 1903, having declined from 15,286,093 pounds of refined copper to 14,961,885 pounds of refined copper in 1904. The quantity of rock mined during the year was 750,189 tons, and the quantity stamped was 642,820 tons, which yielded 22,662,070 pounds of mineral. The total cost per pound of refined copper rose to 12.98 cents in 1904, as compared with 11.50 cents in 1903; the principal cause for the increase being the larger outlay for construction which rose from 0.15 cent per pound to 1.08 cents per pound. The cost at the mine per pound of fine copper was 10.54 cents in 1904 against 9.97 cents in 1903. The smelting charges, freight, eastern expenses, interest, commissions, etc., aggregated 1.36 cents per pound in 1904 as compared with 1.38 cents per pound in 1903. The cost of stamping the rock per ton was slightly decreased, having been 26.24 cents per ton in 1903 and 26.03 cents per ton in 1904. The gross value of the fine copper produced and sold at an average of 13.24 cents during the year 1904 was $1,981,361.52. The running expenses at the mine aggregated $1,576,924.39 and the smelting, transportation, and selling expenses footed up to $203,627.93. This left a gross profit from operations of $200,809.20. The construction expenses totaled $161,958.50, leaving as a surplus for the year $38,850.70.

Osceola.—The Osceola Consolidated Mining Company had a very much better year both as to financial returns and as to quantity of output than in 1903, the year 1904 marking tne conversion of the first year's operations of what is termed by the directors the "Greater Osceola." The quantity of rock stamped in 1904 was 1,095,520 short tons as compared with 924,400 tons in the year 1903. The quantity of mineral obtained increased from 21,904,243 pounds to 27,457,497 pounds, the production of fine copper rising from 16,059,636 pounds to 20,472,429 pounds. The cost of production of the fine copper per pound declined from 10.29 cents in 1903 to 9.96 cents in 1904, the cost in the year 1904 being distributed between 8.04 cents for mining costs, 0.65 cent for construction, and 1.27 cents for smelting, freight, etc.

The copper produced during the year was sold at an average of 13.19 cents, yielding $2,700,470.88, which was increased by other sources of revenue to $2,701,820.23. The running expenses at the mine aggregated $1,646,374.10, while the smelting, freight, and other charges figured up $259,642.45, leaving as a gross profit $795,803.68. The construction expenses amounted to $132,983.91, leaving a net profit for the year of $662,819.77, out of which there were paid in dividends $288,450.

The Osceola has also introduced the use of additional rolls for each head of stamps, and is compounding the steam end of the stamps. The results have been so encouraging that the entire equipment of the six heads is under way. It is to be supplemented by additional concentrating machinery.

Atlantic.—As a result of the abandonment of the workings tributary to one of the shafts at the north end of the Atlantic mine, the average yield of the rock stamped was increased during the year 1904 to 13.63 pounds per ton as compared with 12.76 pounds in 1903. The mill, besides treating 34,030 short tons of Winona rock, crushed 390,526 short tons of Atlantic rock, which yielded 7,149,640 pounds of mineral and 5,321,859 pounds of refined copper.

The cost was $1.022 per ton for mining and surface expenses, and the cost per ton of transportation to mill was 7.72 cents; the cost of stamping and separating, 26.63 cents, and the cost of freight and marketing the product was 16.84 cents. This made the total running expenses per ton of rock $1.5339, and including construction, $1.5484, the gross value of the product per ton of rock treated having been $1.8185. There was realized from the refined copper made an average charge of 13.344 cents per pound, or a total sum of $710,182.24. The working expenses having been $599,039.33, there was left a gross mining profit of $111,142.91, and a net profit of $105,913.91. A dividend of $50,000 was paid out of the accumulated surplus.

Copper Range Consolidated.—The Copper Range Consolidated Company, which controls the Baltic and Trimountain mines, and owns a half interest in the Champion mine, nearly reached its full scale of operations during 1904. The production was curtailed for one month owing to the strike of the miners in February, but in spite of this the total output of the three mines increased from 30,382,446 pounds in 1903 to 34,601,913 pounds in 1904. The records of the individual mines are as follows:

The Baltic crushed 535,624 short tons of rock, which yielded 12,177,729 pounds of copper, an average of 22.74 pounds per ton of rock as compared with 21.58 pounds in 1903. The gross receipts were $1,586,031.26, the average price received for copper having been 12.988 cents. The operating expenses were $996,092.59; taxes and interest amounted to $29,486.30, and construction to $65,583.29, leaving a net profit of $494,869.08. The total cost per pound of copper figured out 8.42 cents as compared with 8.88 cents in 1903.

The Champion Mining Company increased its production from 10,564,147 pounds to 12,212,954 pounds of refined copper in 1904, the amount of rock stamped having been 442,061 short tons, which yielded an average of 27.63 pounds per ton of rock. With average receipts for copper sold of 13.028 cents, the gross receipts figured up $1,591,109.71, against which there were operating expenses $872,250.78, taxes and interest $63,076.87, and construction expenses $209,149.13, thus leaving a net profit of $246,632.93, out of which a dividend of $200,000 was paid. The cost per pound of copper figured out 7.66 cents in 1904 as compared with 8 cents in 1903. The Champion is making an addition to its mill of two heads.

The Trimountain Company made a record in 1904 of 10,211,230 pounds of fine copper in 1904 as compared with 9,237,051 pounds in 1903. This product is obtained from 534,640 short tons of rock, yielding 19.1 pounds of copper per ton as compared with 18.2 pounds of copper per ton in 1903. The gross receipts were $1,396,188.30, the average price received for copper having been 13.67 cents; but operation expenses amounted to $959,624.78, taxes and interest added, $49,822.85, and construction $64,519.74, leaving a net profit of $322,220.93. The cost of copper came down in 1904 to 9.88 cents, as compared with 11.7 cents in 1903, cost of construction included.

The net income from mining operations of the Copper Range Consolidated Company was $1,602,975.10, out of which there was paid in dividends to the Champion Copper Company $200,000. The net earnings of the Copper Range Railroad Company were $53,068.96. The net dividends and other income of the Copper Range Company amounted to $84,386.42, and there were received from the Copper Range Consolidated Company $54,961.46, and under the Trimountain agreement $70,444.74. Taxes and general expenses deducted left a sum of $1,591,573.36, and deducting $227,891.03, as one-half of the undivided profits of the Champion Copper Company which belongs to the St. Mary's Mineral Land Company, a balance of net income remains of $1,363,682.33.

Franklin.—The Franklin Mining Company produced during the year 1904, 8,447,335 pounds of mineral, yielding 4,771,050 pounds of refined copper, as compared with 5,309,030 pounds in 1903. The total receipts for copper amounted to $545,213. There were also included in the total receipts of $985,403, $179,845 for copper carried over from the previous year, and $237,500 for loans. The mining expenses amounted to $580,084, while the outlays for smelting, transportation, selling, etc., figured up $77,333. Loans were repaid to the amount of $267,500.

Isle Royale.—The Isle Royale Copper Company confined its productive operations to the main part of the mine, shipping enough rock to the mill to keep one head only in operation. The result is that the product fell off, having been 2,442,905 pounds of fine copper during 1904, as compared with 3,134,601 pounds in 1903. This product was obtained from stamping 154,830 short tons of rock, which yielded an average of 15.8 pounds of fine copper per ton of rock stamped.

The costs when figured up were 12.02 cents, and in addition thereto 1.28 cents per pound of product otherwise expended for explorations, railroad expenses, etc. The copper sold at 13.19 cents per pound, the total receipts having been $341,951.67, against which there were outlays of $288,783.42, leaving a gross profit of $53,168.25. Exploration work, railroad expenses, and additions to the stamp mill cost $36,065.42, leaving a net profit of $17,102.83. The company has opened very promising ground in what is known as section 11, and has taken steps for developing this part of the property.

Mohawk.—The Mohawk Mining Company, during the second year of production, had two stamps in operation for the full year, and a third head for ten months. A fourth stamp has been ordered, and when the entire equipment is fitted with the steeple compound patent the four heads will stamp from 2,800 to 3,000 tons daily. With practically three stamps of the simple type in operation the mill crushed 459,162 short tons of rock, which yielded 8,149,515 pounds of copper. The average yield of the rock was somewhat disappointing, having decreased from 21.79 pounds per ton in 1903 to 17.75 pounds in 1904. Even if the yield does not increase, the equipment of the Mohawk Mining Company when completed would indicate a production of close to 16,000,000 pounds per year.

The copper was sold at an average of 12.99 cents, the total receipts having been $1,058,502.25. The working expenses aggregated $749,624.85, and there was expended for additions to the plant and for new machinery $178,400.08, leaving a surplus for the year of $130,477.32.

Michigan.—The Michigan Mining Company has continued explorations on what is called the branch vein with encouraging results. During the year there were stamped at the Mass mill 125,055 short tons of rock. The mill, however, was not in full operation until May, and has since then crushed from 11,500 to 12,500 short tons of rock. The production included 2,394,770 pounds of mineral and 1,304,465 pounds of mass copper, which together yielded 2,746,127 pounds of refined copper, which sold at an average of 13.056 cents. The receipts were $358,539.53 for copper and $60,629.14 for interest and on account of assessments. The expenditures aggregated $355,093.92.

Mass.—The Mass Consolidated Mining Company stamped during 1904, 105,614 short tons of rock, which yielded 2,909,830 pounds of mineral and 2,182,931 pounds of refined copper, which cost on an average 11.3 cents per pound, and the average price obtained was 13.1 cents per pound. The company is developing the Knowlton and Butler lodes.

Allouez.—During 1904 the management of the Allouez mine struck the Kearsarge lode and has begun its development under very promising auspices. No. 1 shaft is being rapidly sunk and equipped, and a second shaft has been started. The rock obtained from the new development will be crushed in the Centennial mill.

Winona.—The Winona Copper Company produced 1,784,157 pounds of refined copper from 89,237 short tons of rock crushed at the Atlantic mill. The result of these tests of the productiveness of the property has led to the conclusion that sufficient ground should be opened up to admit of an output of 1,000 tons of rock per day when the expenditure necessary for the erection of a stamp mill will be fully realized.

Keweenaw.—The Keweenaw Copper Company has been organized by Charles A. Wright, of Hancock, to acquire and charter the existing road of the Lac La Belle and Calumet Railroad Company. This road will be extended from Calumet to Lac La Belle and will be known as the Keweenaw Central Railroad. The copper company owns a large bed of mineral lands, aggregating about 8,000 acres, on which extensive explorations are to be undertaken.

MONTANA.

The settlement of some of the most important suits in the protracted litigation in Butte, the entry into the camp of strong new interests, and the improvement and enlargement of mining, concentrating, and smelting plants promise to lead to a very considerable increase in the production of copper in Montana. The magnitude of the operations of the Butte mines is shown by the reports submitted to the commissioner of taxes. They cover the fiscal year ending June 1, 1905, so that no direct deductions as to yield of copper from the returns of the production of the latter for the calendar year can be made. The tonnage of copper ore reported for the year ending June 1, 1905, is as follows:

	Tons.
Amalgamated Copper Company:	
Anaconda	1,473,644
Boston and Montana	1,138,307
Butte and Boston	260,433
Parrot	167,963
Trenton	150,296
Washoe	102,941
United Copper Company:	
Montana Ore Purchasing Company	170,169
Hypocka	77,105
Guardian	43,591
Corra and Rock Island	122,607
Speculator	112,940
Original	343,850

During 1904, according to the annual report of the Amalgamated Copper Company, the companies owned wholly or in part by it produced 252,000,000 pounds of copper, this, however, including a certain amount of copper derived from custom ores. Of this quantity, the Amalgamated Company, as such, received the benefit of 202,000,000 pounds. During 1904 the great Washoe concentrating and smelting plant, built in 1901 and in 1902, was in full operation, and important economies were effected. Betterments are now being carried out in the Boston and Montana plant at Great Falls.

The annual report of the United Copper Company shows larger earnings. Enlargements are now being made both in mining equipment and in the smelter, which it is expected will carry the annual product up to 50,000,000 pounds of copper per annum.

The Pittsburg and Montana Company continued developments at the mines and completed its reduction plant. The company will rank among the producers in 1905.

Interests identified with Lake Superior iron and copper mining and with the Bonanza Circle group of mines at Bisbee, Ariz., have purchased the Speculator mine at Butte and other mines and have formed the North Butte Mining Company. The Speculator mine has been a producer for a number of years, shipping its ore to Butte and other smelters outside of the State. It is proposed to develop the property greatly, and a considerable addition to the Butte output of the metal will follow. As yet no plans for the erection of a smelting plant have been formulated. It is estimated that the copper contents of the ores mined in 1905 will be close to 20,000,000 pounds.

The Cataract Copper Mining Company has developed by tunnels a series of claims in the Cataract district, in Jefferson County, Mont., 18 miles from Butte, and has erected a concentrating plant and a smelting furnace. There have been offered in the London market 115,000 shares of £1 each to provide funds for doubling the capacity of the concentrator and smelter in order to enable the company to treat 600 tons of ore per day.

ARIZONA.

Practically every producer of any consequence in Arizona increased its output in 1904 as compared with 1903. This is true of the Copper Queen, the largest producer, the California and Arizona, the Arizona Copper Company, the United Verde, the Old Dominion, and the Shannon.

Owing to the fact that custom smelting is becoming a feature of some of the plants in Arizona, there is some danger of attributing to that Territory copper really originating in other States and Territories or in Mexico. Particular pains has been taken to avoid such a duplication, and this may explain the apparent discrepancy between local estimates and the official figures.

The establishment of the large smelting works at Douglas and the development of a comprehensive system of railroads have done a good deal to stimulate copper production. There is a growing interchange of ores, making smelter mixtures more suitable. Thus, a considerable tonnage of sulphur ores from the Bisbee district is shipped to Globe, while oxidized ores from the latter district go to the former to be used for converter linings. The Copper Queen smelter at Douglas also treats the concentrates from the Moctezuma mines at Nacozari, Sonora, Mexico, and the ores of the Imperial Copper Company, which has reopened the Old Boot mine in the Silver Bell district, to the southwest of Tucson. The Copper Queen smelter is being enlarged.

Bisbee district.—A very considerable increase in the production of this district has taken place through the new developments in the Copper Queen properties and in the so-called Bonanza Circle mines, to the first of which belongs the Calumet and Arizona Company, and two others are being added as producers during the current year.

The Calumet and Arizona Mining Company had a very prosperous year, producing a total of 15,819 short tons of refined copper, for which an average price of 12.562 cents was realized. The total quantity of ore smelted was 205,807 short tons, the percentage recovered being 7.66. The product in gold and silver was $195,926.18. During the year additional ore properties were developed, increasing the reserves considerably, while some of the ores opened out will make it possible to flux the ores with greater facility and to keep an economical smelting mixture. During the year there were paid in dividends $1,300,000.

The second of the group is the Calumet and Pittsburg Mining Company, whose receipts, including $1,000,000 received from the sale of stock, were $1,114,342.70. The expenditures included $590,195.25 payment on property.

The Lake Superior and Pittsburg Mining Company reported for the year receipts aggregating $1,501,274.50, there having been received from sale of stock $1,495,520, while included in the expenditures were $775,000 payments on property, and $373,000 payments for notes on the Lake Superior and Pittsburg Development Company.

The Lake Superior and Pittsburg and the Pittsburg and Duluth companies will produce during the year 1905 between 9,000,000 and 10,000,000 pounds of copper, which will be made in a furnace now being added to the equipment of the smelting plant of the Calumet and Arizona Company at Douglas. The latter will probably not produce in excess of 32,000,000 pounds of fine copper during 1905.

Clifton district.—The leading producer in the Clifton district is the Arizona Copper Company (Limited), a Scotch corporation, which, besides its mines, concentrating works, smelting plant, sulphuric-acid plant, and other equipment, owns the railroad, 70 miles long, connecting Clifton with the Southern Pacific at Lawrenceburg, N. Mex., and an eastern line which connects the extension, 39 miles, with the El Paso and Southern at El Paso and the Southern Pacific at Pachita.

The financial statement which covers the fiscal year ending September 30, 1904, showed the receipts to have amounted to £852,814, of which £725,191 was from sales of copper and sulphide and £127,457 was from railroad earnings. The expenses totaled £542,822, the principal items being £479,133 for mining and smelting, £40,891 for railway operating expenses, and £22,798 for general charges. The net earnings, therefore, were £309,992. The balance which had been brought forward from the previous year having been £14,863, there was available a total of £324,855, from which there was paid for interest £9,162, income tax £13,440, while £40,000 was reserved for the redemption fund. Dividends on two classes of stock were paid to the amount of £24,531, leaving a balance to carry forward of £238,272. The latest available figures with reference to the operations of the plant cover the six months ending September 30, 1904. During that period there were shipped to the concentrating plant 230,478 short tons of ore, which produced 35,814 tons of concentrates. There were also leached 36,070 tons of tailings, the precipitate being smelted with the ores and concentrates. The smelter handled 53,220 tons of ores and concentrates and 639 tons of precipitate, producing 6,949 tons of blister copper.

The company is building an additional concentrator, which it is expected will add about 500,000 pounds of copper per month to its output.

The Shannon Copper Company produced during the fiscal year ending August 31, 1904, 10,788,891 pounds of fine copper and shipped 11,059,909 pounds, for which the average price of 12.516 cents per pound was received. The company purchased a group of claims known as the "Little Coronado." The average grade of the ore from the mine during the year was 3.41 per cent and the average contents of the concentrates 11.5 per cent of copper. The average cost of mining and transporting to the smelter amounted to $2.05 per ton.

The vigorous development of the property justifies the management in the belief that the output of the company may be increased to about 1,500,000 pounds of copper per month. The company is considering the question of building a converter plant, its matte at the present time going to the works of the Arizona Copper Company.

The Detroit Copper Company, controlled by Phelps, Dodge & Co., produced in 1904 16,456,000 pounds. A new concentrating plant is in course of construction which will permit of a considerable addition to the product.

Globe district.—During the year 1904 the Old Dominion Copper Mining and Smelting Company, the principal producer in the Globe district, secured to some extent the advantages of the improvements which have been under way for some time, and which, it is expected, will be completed in the year 1905. It is estimated that then the product will amount to about 35,000,000 pounds of fine copper per annum. During 1904 the plant produced 15,569,109 pounds of blister copper and 157,741 tons of matte, the fine copper contents of which were 15,368,147 pounds. There were also contained in the blister 86,124 ounces of silver and 1,523 ounces of gold. With the copper in the form of converter bars realizing 12.11 cents, the total receipts, including the precious metals, were $1,941,617.02, while the expenses, including cost of custom ores and extraordinary expenses, were $1,638,913.63; and transportation, commissions, etc., amounted to $161,104.35, leaving a profit for the year of $141,599.04. The mining developments during the year have been favorable, and there was begun the building of a new concentrating plant with a capacity of 300 tons per day. It is so designed that this capacity may be readily increased to about 450 tons per day. For the old smelting works with two furnaces a new plant containing three furnaces has been substituted, which was started up in September of 1904. A notable feature of the year has been the purchase of sulphide ores from other quarters. Prominent among these are ores from the Copper Queen Company and from the Copper Belle Mining Company, at Gleeson, whose lean matte was taken. It is expected that this will considerably reduce the cost of smelting, the figure reached in December, 1904, having been $2.36. The company is running three furnaces, one on the old slag dump, which will carry 40 or 50 pounds of copper to the ton, and on flue dust, a considerable quantity of which has accumulated pending the completion of the briquetting plant.

The cost of mining has been brought down considerably. During the year 1904 it amounted to $4.55 for putting the ore into the smelter bins, aside from development and pumping; $1.30 for pumping, and 95 cents for development.

In the Globe district a new company has been formed under the title of "The Arizona Commercial Company," which is developing mines in the district. It is probable that upon the completion of the railroad connections some ore will be delivered to the Old Dominion smelting plant, while later on probably the company will be equipped with works of its own.

The Bradshaw Copper Mountain Mining and Smelting Company, which succeeded the Val Verde Company, lost its smelting plant by fire, and is considering the question of building new works.

Jerome district.—The effect of the remodeling of the smelting plant of the United Verde Company was reflected in the increased production during 1904. It is probable that a further enlargement of output will be effected in 1905. When the improvements to the plant are fully completed it will consist of six stacks, with a capacity of nearly 1,800 tons per day.

The Equator Mining and Smelting Company, in which Senator W. A. Clark is also interested, entered the ranks of producers during 1904, and will probably show a larger production during the current year.

UTAH.

The principal producers of copper in Utah, all of whom increased their output in 1904, were the United States Mining Company, the Utah Consolidated, and the Bingham. Besides these, the American Smelting and Refining Company treated a considerable quantity of Utah ores. This company has decided to build a very large copper smelting plant in the Salt Lake Valley, which will considerably add to the facilities for custom smelting and will stimulate production. The Yampa Smelting Company began operations during the year 1904.

The United States Mining Company operates properties in both the Bingham and the Tintic districts, and at its smelting plant also treats custom ores. The mines of the company in the Bingham district are capable of yielding 15,000 short tons of ore per month, while the mines of the Centennial Eureka group can readily furnish 8,500 tons per month. The smelting plant, which consists of 6 furnaces and 2 stands of converters, is capable of dealing with 25,000 tons of ore per month. The company has purchased a controlling interest in the De la Mar copper refining plant at Chrome, N. J. The stockholders have authorized the increase in the capital stock from 500,000 to 600,000 shares, of which increase 70,000 shares have been offered at par, $25, to the stockholders. The proceeds are to be used for the purchase of the copper refining plant and for further extensions of the refining and smelting interests of the company. The company controls the Mammoth property in California, has lead smelting furnaces in Utah, and proposes to build a lead desilverizing and refining plant.

The annual report of the Utah Consolidated Mining Company shows that the production in 1904 was 13,553,483 pounds of copper, 268,880 ounces of silver, and 23,374 ounces of gold, as compared with 12,715,693 pounds of copper, 198,811 ounces of silver, and 20,027 ounces of gold in 1903. The smelter treated 233,714 short tons of ore, including 14,813 tons of custom ore, there being produced 13,884,115 pounds of copper. The developments at the mine show reserves of 1,090,000 tons of sulphide ore, as compared with 1,075,000 tons in March, 1904. The sales during 1904 amounted to $2,250,799, from which there must be deducted $224,761 for refining charges. Figuring an increase in the value of the stocks of bullion and copper at the seaboard, at the smelter, and in process, the receipts amount to $2,235,213. Deducting $1,070,865 for mining, smelting, and sundry charges, a balance of $1,164,348 remains, out of which $900,000 in dividends were paid. The company has enlarged its smelting plant and is likely during 1905 to increase its product to about 18,000,000 pounds of copper.

The annual report of the Boston Consolidated Mining Company for the year ending September 30, 1904, shows that there were delivered to the Bingham smelter 47,846 short tons of ore, for which there were received $257,915. Rentals added $728. The expenses figured up to $131,398, of which ore extraction called for $97,510, leaving a net profit of $127,245. The ore averaged 3.3 per cent of copper. The company has voted to increase the capital stock by 125,000 shares, par £1, and to issue £250,000 of 6 per cent convertible bonds for the purpose of building a concentrating plant for the treatment of 2,500 tons daily of the ores.

The Bingham Consolidated Company, which has added a new furnace to its smelting plant, owns mines in both the Bingham and the Tintic districts, the Dalton & Lark having developed a large ore body. The company is treating from its own properties about 15,000 short tons of ore per month, and is handling about 5,000 tons per month of custom ore.

The Utah Copper Company is developing on a large scale the low-grade ore of the Bingham porphyry belt. A concentrating mill capable of treating about 700 tons of ore per day has been in operation since the fall of 1904, having been enlarged from 400 tons during the summer. It is proposed to increase the capacity to 4,000 tons per day, the mill to be completed in 1907. The concentrates are being shipped to custom smelters.

Adjoining is the Ohio Copper Company, which is milling on a moderate scale. The building of a concentrating plant to treat 500 tons per day is under consideration.

A number of other groups of mines in the Bingham district are being developed. Among these is the New England Gold and Copper

Company, which is operating a small concentrating plant, the Bingham Central Mining Company, the Bingham-New Haven Company, and the Utah-Apex Company.

A very important addition to the copper production of Utah will come during 1905 from the starting of the Newhouse Mines and Smelters Corporation, which is placing on the market the product of the Cactus mine in Beaver County. The first unit of the concentrating plant, which will treat about 800 tons per day, is nearly ready for operation. The concentrates will be shipped to custom smelters.

The Majestic Copper Mining and Smelting Company is expected to be a producer of copper during 1905.

CALIFORNIA.

A very considerable addition to the future copper product of California will come from the undertaking entered into by the United States Mining Company in the Shasta County district. The Mammoth group of mines in that district has been acquired after examination of the property, which indicated that there are in sight about 200,000 tons of ore running 5 per cent of copper and better. Based upon the development, a smelting plant is now under construction, with an estimated capacity of 1,000 tons per day, the smelter being equipped with three stacks, two of which will be in operation at the same time, the third being held in reserve. It is estimated that the copper product will amount to 1,250,000 pounds per month.

An English company, the Fresno Copper Company (Limited), is building at the mines in Fresno County a works which is to have two furnaces and a converter plant.

The plant of the Great Western Gold Company, at Redding, was not started in 1904, but will be a contributor to the product of the State during the current year.

The Balaklala mine, in Shasta County, has been purchased by the White Knob Copper Company, which has abandoned its mines at Mackay, Idaho. The smelting plant at the latter property is to be removed to California.

The Bully Hill Company, which produces a little over 4,000,000 pounds of copper per annum, has been acquired by interests identical with the General Electric Company.

IDAHO.

The copper producea in Idaho during 1904 has come entirely from ores shipped to distant smelters, the local works not having been in operation. The plant of the Ladd Metals Company, at Landon, will, however, treat ores from the Seven Devils district during the current year.

OREGON.

During 1904 there was built at Takilma, in the Waldo district, Josephine County, in southern Oregon, the plant of the Takilma Smelting Company. Considerable development has been done in the district, which, however, suffers from inadequate means of transportation.

WYOMING.

In the Encampment district the principal producer is the North American Copper Company, which operates the Ferris-Haggerty property.

ALASKA.

The production reported for Alaska during 1904 was entirely from copper ores shipped to the Tacoma works. There has been started, however, the copper smelting plant of the Alaska Copper Company, at Copper Mountain.

THE SOUTH.

The Tennessee Copper Company is preparing for a considerable increase in production, the plans under execution making it probable that the annual production will exceed 20,000,000 pounds. During the year 1904 the management discontinued the old method of heap roasting and started pyritic smelting, mining activity being restricted, although mining development was steadily pursued and led to an increase of 650,000 tons in the ore reserves. The amount of ore raised was 144,799 short tons, as compared with 287,465 tons during the previous year. There were smelted 315,163 tons of material, including 166,901 tons of roasted ore, equivalent to 185,446 tons of raw ore, 54,870 tons of raw ore, 2,695 tons of custom ore, the balance being fluxes, by-products, matte resmelted, and briquetted flue dust. The product amounted to 8,617,697 pounds of copper, in converter bars, 2,170,372 pounds of refined copper in ingots, and 428,800 pounds in increase of material in process. The custom ore yielded 186,411 pounds of copper. The cost of fine copper in pig on cars at the mine footed up to $3.2704 per ton of ore, or to 9.18 cents per pound of copper, the cost of refining adding 0.41 cent per pound.

The total receipts amounted to $1,172,716, including sales of 8,443,979 pounds of copper at an average of 12.76 cents per pound. The total expenses were $985,720, which included $228,899 for delivering ore at the smelter, $432,281 for smelting and refining, and $108,865 for freight, commissions, and other costs. The profit for the year was $186,996, to which was added a balance brought forward of $498,150, thus reaching a balance of $685.146, out of which a dividend aggregating $218,750 was paid. The capacity of the smelting plant is being increased by 4 new blast furnaces of large size, making a total of 7 furnaces. A new stand and 5 shells have been added to the converter plant.

THE COPPER PRODUCTION OF THE WORLD.

The following summary of the production of copper in the world is based upon the statistics gathered by Messrs. Merton & Co., of London, modified where official returns are available:

The copper production of the world, 1896–1904.

[Long tons.]

Country.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
EUROPE.									
Great Britain	555	555	640	635	777	532	480	536	[a]500
Spain and Portugal:									
Rio Tinto	34,501	33,923	33,705	34,370	35,732	35,348	34,480	35,810	33,480
Tharsis	12,000	[a]11,000	[a]11,150	9,448	7,965	7,427	6,710	6,320	5,620
Mason and Barry	[a]3,900	[a]4,300	3,600	3,600	3,460	3,729	3,330	2,430	2,950
Sevilla	1,025	810	800	1,200	1,460	1,292	1,545	1,105	1,330
Tinto and Santa Rosa	3,400	500	815	1,000	1,580	1,640	1,285	1,430	3,655
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	18,735
Other German	1,800	2,185	2,040	2,675	2,020	2,940	2,855	2,230	2,310
Austria	1,065	1,210	1,110	915	865	1,015	1,027	1,055	1,275
Hungary	205	445	430	590	490	335	485	330	175
Sweden	500	545	480	520	450	320	455	455	390
Norway	2,500	3,450	3,615	3,610	3,935	3,375	4,565	5,915	5,415
Italy	3,400	3,480	2,965	3,032	2,797	[a]3,000	3,370	3,100	3,335
Russia	5,832	6,941	7,291	7,533	7,893	6,263	8,675	10,320	10,700
Turkey	....	975	470	920	520	980	1,100	1,400	950
Total	88,948	90,829	89,461	93,383	91,009	91,161	91,552	94,056	90,820
NORTH AMERICA.									
United States	205,384	220,571	235,050	253,870	270,588	268,782	294,423	311,627	362,739
Canada	4,190	5,938	8,040	6,731	8,446	18,496	17,486	19,321	19,183
Newfoundland	1,800	1,800	2,100	2,700	2,700	2,336	2,586	2,710	2,200
Mexico:									
Boleo	9,940	10,170	9,435	10,335	11,050	10,795	10,785	10,480	10,945
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	[a]50,000
Cuba	....	....	....	....	....	....	....	....	490
Total	222,524	242,679	261,625	282,636	303,784	320,044	355,280	384,138	445,557
SOUTH AMERICA.									
Chile	23,500	21,900	24,850	25,000	25,700	30,780	28,930	30,930	30,110
Bolivia:									
Corocoro	2,000	2,200	2,050	2,500	2,100	[a]2,000	[a]2,000	[a]2,000	[a]2,000
Peru	740	1,000	3,040	5,165	8,220	9,520	9,096	9,496	9,000
Argentina	100	200	125	65	75	780	240	135	155
Total	26,340	25,300	30,065	32,730	36,095	43,080	40,266	42,561	41,265

[a] Estimated.

The copper production of the world, 1896–1904—Continued.

Country.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
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	5,475
Namaqua Company	1,980	2,150	2,400	2,350	2,300	2,400	1,700	600	2,300
Total	7,450	7,440	7,110	6,490	6,720	7,472	4,450	5,230	7,775
ASIA.									
Japan	21,000	23,000	25,175	27,560	28,121	27,475	29,775	31,360	34,850
AUSTRALASIA.									
New South Wales	4,467	6,922	5,743	5,394	a 5,500	6,802	a 7,000	a 7,600	a 8,000
South Australia	4,877	4,705	5,000	a 6,500	a 5,386	6,770	6,847	a 7,000	a 7,000
Tasmania	1,928	4,956	5,200	a 9,000	a 10,000	a 12,000	a 9,650	a 8,600	a 8,657
Queensland	....	....	....	....	384	3,061	3,784	4,916	a 5,000
Total	11,272	16,583	15,943	20,894	21,270	28,633	27,281	28,116	28,657
Grand total	377,534	405,831	429,379	463,693	486,999	517,865	548,604	585,461	648,924

a Estimated.

It will be observed that since 1899 nearly the entire increase in the production of copper has been due to the development of the copper-mining industry of North America, the United States, Mexico, and Canada, the output of the rest of the world having remained practically stationary.

The following table clearly illustrates this fact:

Copper production of the world, 1899–1904.

[Long tons.]

Year.	World's production.	North America.	Other countries.
1899	463,693	282,636	181,057
1900	486,999	303,784	183,215
1901	517,865	320,044	197,821
1902	548,604	355,280	193,324
1903	585,461	384,138	201,323
1904	648,924	445,557	203,367

In six years the production of copper in North America increased 162,921 long tons as compared with 22,310 tons for the rest of the world. The United States alone increased 108,869 tons in that time. It is certain that the year 1905 will greatly emphasize that preponderance, since a very large increase in the output is assured for the United States, for Mexico, and for Canada.

FOREIGN COUNTRIES.

MEXICO.

The copper mining and smelting industry of Mexico has taken enormous strides in recent years. Unfortunately, exact statistical data are not available as to the production, and the figures presented thus far have been largely guesswork. Now that the copper contents of furnace material imported into this country are officially determined, it is possible to get more closely at the facts. Our importations of Mexican ores, mattes, and blister aggregated in 1904, 118,769,554 pounds. As an offset to these imports, it is necessary to note exports to Mexico from this country of ores and mattes amounting to 15,175 long tons, valued at $1,121,798. Estimating the copper contents to be about 11,000,000 pounds there remain about 107,700,000 pounds as the product of the Mexican mines. There were imported directly from Mexico into England 7,465 long tons of fine copper, and into France 4,340 long tons, equivalent to 26,443,200 pounds fine, which is nearly all Boleo copper. This would indicate, roughly, a production, in 1904, of copper in Mexico of 134,000,000 pounds, or 60,000 long tons, which is a somewhat larger quantity than is usually credited to that country, the second producer in the world.

By far the largest of the Mexican producers is the Greene Consolidated, which in 1904 yielded 55,000,000 pounds of fine copper, and will turn out metal at a heavier rate in 1905. The Boleo Company in Lower California produces regularly from 10,000 to 11,000 long tons of fine copper. The Moctezuma mines at Nacozari, controlled by Phelps, Dodge & Co., add close to 10,000,000 pounds annually. The Tezuitlan Copper Mining and Smelting Company, which operates in the State of Puebla, is treating per month between 6,000 and 7,000 tons of ore, which is said to average 6 per cent of copper and $3 in gold and silver. In the State of Guerrero the Mitchell Mining Company is opening up the La Dicha mine and is completing a smelting plant. The Mazapil Company, whose mines are in the State of Zacatecas, and which has been producing matte, is building a new smelting plant at Saltillo. The establishment of large custom smelting plants at a number of centers and the rapid extension of railroads hold out the promise of a steady increase in the production of copper in Mexico.

CANADA.

The production of copper in British Columbia has shown a steady increase, and will continue to grow, since preparations are being completed for a further enlargement of operations. The production, which was 9,997,080 pounds fine in 1900, was 27,603,746 pounds in

1901, 29,636,057 pounds in 1902, 34,359,921 pounds in 1903, and 35,710,128 pounds in 1904. By districts the output was distributed as follows:

Copper production of British Columbia, 1902–1904, by districts.

[Pounds.]

District.	1902.	1903.	1904.
Boundary	14,955,582	18,485,542	22,066,407
Rossland	11,667,807	8,652,127	7,119,876
Coast	2,496,681	6,861,171	5,960,593
Yale-Kamloops	....	6,409	328,380
Nelson	491,144	346,218	220,500
Various	24,843	8,454	14,372
Total	29,636,057	34,359,921	35,710,128

The ores, generally speaking, are low in grade, the average recovery having been in 1904 for the Boundary camp, 1.38 per cent; for Rossland, 1.12 per cent, and for the Coast district 3.68 per cent. The ores, however, carry the precious metals.

The principal producer in the Boundary district is the Granby, which in 1904 treated from its own mines 549,704 short tons of ore and 46,548 short tons of custom ore, which yielded 13,421,226 pounds of copper, 180,844 ounces of silver, and 47,966 ounces of gold. The company is adding to and remodeling the smelting plant so that it will be possible to treat from 72,000 tons to 75,000 tons of ore per month, which will increase the copper product to a rate of 20,000,000 to 22,000,000 pounds per annum.

The British Columbia Copper Company (Limited), operates the Mother Lode mine in Deadwood camp and has a smelter at Greenwood which treated 210,484 short tons of ore in 1904, including 172,753 of Mother Lode ore, 22,262 tons of Le Roi No. 2 ore, and 9,869 tons of Emma ore. It produced 2,489 short tons of matte and 1,467 short tons of blister, which contained 5,081,743 pounds of copper, 36,404 ounces of gold, and 118,419 ounces of silver.

The third company of the Boundary district, the Montreal and Boston Company, has been reorganized, the Dominion Copper Company acquiring the properties. It is the purpose of the new company to complete the smelter to its full capacity of 1,500 tons per day and to put up a converting plant.

While the ore shipments of the Rossland district declined to 312,205 short tons, progress has been made in the direction of putting up concentrating plants to handle the low-grade ores. The largest company, the Le Roi Mining Company (Limited), shipped 132,496 short tons of ore, the smelting plant being located at Northport, Wash.

In the coast districts the most important operation was that of the

Tyee Copper Company's smelter at Ladysmith, which treated 57,450 short tons of Tyee ores and 7,953 tons of custom ores, producing 6,026 tons of matte, carrying 5,120,870 pounds of copper, 179,769 ounces of silver, and 11,089 ounces of gold.

The Province of Ontario, according to official returns, produced 2,163 long tons of copper, the greater part of which was derived from the Sudbury nickel district. An increase in the output is expected for 1905.

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
1904	546,030,153	2,532,064	50,193,920	1,865,034	4,397,098

Since July, 1903, the Bureau of Statistics of the Department of Commerce and Labor has collected data relative to the copper contents of ores and mattes imported into this country, and thus a serious source of uncertainty has been removed.

For the calendar year 1904 the imports were as follows:

Imports of copper ore and matte in 1904, by countries.

Imported from—	Quantity.	Copper contents.	Value.
	Long tons.	*Pounds.*	
Germany	3	4,573	$1,033
British North America	183,102	15,046,131	1,453,575
Mexico	69,934	20,803,961	2,522,795
South America	166	91,509	10,508
Other countries	15,029	3,001,548	320,167
Total	268,234	38,947,722	4,308,078

Considerable quantities of ore and of matte cross the borders from Canada and from Mexico for smelting or for converting at works in this country, and at times mattes produced at smelters in the United States are forwarded for bessemerizing to Mexico. For the time being the latter movement has ceased.

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, 1903, and 1904:

Imports of copper pigs, bars, ingots, plates, old and other unmanufactured, in the calendar years 1901, 1902, 1903, and 1904, by countries.

[Pounds.]

Country.	1901.	1902.	1903.	1904.
France	1,022,178	843,523	1,426,279	22,075
Germany	3,117,951	1,245,354	1,600,766	875,329
United Kingdom	43,838,699	27,762,838	18,788,558	19,172,854
Other Europe	....	255,072	240,689	16,943
British North America	953,576	386,361	15,923,760	17,690,656
Cuba	1,013,460	801,016	467,832	368,634
Other West Indies	390,201	190,972	317,112	373,734
Mexico	23,024,376	68,565,175	89,361,100	97,965,593
Japan	224,850	2,643,913	3,604,643	80
All other countries	241,115	435,344	4,477,256	5,858,535
Total	73,826,406	103,129,568	136,707,995	142,344,433
Value	$11,812,216	$13,051,159	$17,262,148	$18,374,941

The copper imported from Great Britain is largely Australian and other blister which is worked in refineries in this country. It will be observed how sharply the imports from Japan have fallen off, the same phenomenon being observed also in the leading European copper markets.

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, 1890–1904.

[Cwts. are long hundredweights of 112 pounds.]

Year ending December 31—	Ore and matte.		Pigs, bars, sheets, and old.		Value of manufactured product.	Total value.
	Quantity.	Value.	Quantity.	Value.		
	Cwts.		*Pounds.*			
1890	431,411	$4,413,067	10,971,899	$1,365,379	$139,949	$5,918,395
1891	672,120	6,565,620	69,279,024	8,844,304	293,619	15,703,543
1892	943,040	6,479,758	30,515,736	3,438,048	245,064	10,162,870
1893	835,040	4,257,128	138,984,128	14,213,378	464,991	18,935,497
1894	87,040	440,129	162,393,000	15,324,925	378,040	16,143,094
1895	276,480	1,631,251	121,328,390	12,222,769	1,084,289	14,938,309
1896	414,265	2,393,914	259,223,924	27,822,280	819,017	31,035,211
1897	181,280	1,199,029	277,255,742	30,597,645	958,379	32,755,053
1898	186,860	755,443	291,955,905	33,598,869	1,190,939	35,545,251
1899	74,540	442,868	246,826,331	41,190,287	1,852,499	43,485,654
1900	200,140	1,332,829	337,973,751	55,285,047	2,257,563	58,875,439
1901	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
1904	....	1,202,537	554,550,030	71,488,116	3,328,818	76,019,471

The extraordinary increase in the exports of copper is one of the salient features of the development of the industry during 1904.

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 1899, 1900, 1901, 1902, 1903, and 1904, and countries to which exported.

[Pounds.]

Country.	1899.	1900.	1901.	1902.	1903.	1904.
United Kingdom	50,675,849	63,522,445	36,819,100	88,972,029	47,140,717	112,224,871
Belgium	5,069,456	12,554,191	4,561,405	8,431,560	4,207,720	9,365,791
France	58,450,866	67,725,989	34,607,042	63,519,881	53,745,221	99,888,455
Germany	49,285,139	67,348,848	37,487,180	56,604,753	71,130,077	103,825,445
Netherlands	69,304,699	101,398,394	61,752,002	96,358,472	96,927,346	147,678,581
Italy	3,449,565	5,550,285	5,045,775	9,108,904	7,774,016	15,297,091
Russia	2,689,610	5,650,423	2,889,270	[a]28,539,742	10,411,679	22,333,578
Austria	6,354,287	11,258,115	8,616,964		[b]16,516,663	29,064,494
Mexico	285,222	296,684	217,437	251,812	165,283	191,429
British North America	985,525	1,616,778	1,232,577	2,811,835	2,644,831	3,472,614
West Indies	5,599	1,317	3,032	97	....	....
China	....	....	....	....	....	10,403,034
Other countries	270,514	1,050,282	1,018,044	69,764	63,971	804,647
Total	246,826,331	337,973,751	194,249,828	354,668,849	310,729,524	554,550,030

[a] Other Europe, including Austria and Russia. [b] Other Europe.

Nearly all the copper which is recorded as being consigned to the Netherlands is really in transit for Germany. The import statistics of Germany furnish a more accurate guide to the quantities which that country takes from the United States. The exports to China make their first appearance in the statistics of 1904. The movement is one which has developed much significance.

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; in 1903, 2,093,103 pounds; and in 1904, 1,088,672 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; none was reexported in 1904.

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, 1903, and 1904, 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	3,937,350
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.	1904.
Baltimore, Md	54,377,355	103,607,256	88,296,071	171,386,493
Boston and Charlestown, Mass	27,917	426,069	512,053	838,321
Newport News, Va	1,568,567	5,070,026	1,969,177	7,626,951
Norfolk, Va	....	598,339	1,771,993	560,536
New York, N. Y	133,540,150	236,622,515	211,879,055	360,644,287
Philadelphia, Pa	3,526,130	5,804,743	3,845,307	9,718,814
New Orleans, La	1,806	1,819	3,014	121,835
Detroit, Mich	387,923	812,828	611,327	1,187,706
Huron, Mich	92,062	208,849	261,820	532,841
Burlington, Vt	434,692	....	491,921	700,561
All other districts	293,226	1,516,405	1,087,786	1,231,685
Total	194,249,828	354,668,849	310,729,524	554,550,030

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 1895 to 1904, both inclusive:

Supply of copper for the United States, 1895–1904.

[Pounds.]

Source.	1895.	1896.	1897.	1898.	1899.
Production of domestic copper	380,613,404	460,061,430	494,078,274	526,512,987	568,666,921
Imports:					
Fine copper in ore and matte, entered for consumption	[a] 5,300,000	[a] 5,900,000	[a] 12,000,000	[a] 19,750,000	[a] 23,800,000
Bars and ingots	7,979,322	11,397,272	16,578,420	54,166,467	71,922,340
Old copper	1,336,901				
Total	395,229,627	477,358,702	522,656,694	600,429,454	664,389,261
Exports:					
Ingots and bars	121,328,390	259,223,924	[b] 277,255,742 [c] 406,598	291,955,905 23,647,968	246,826,331 2,550,149
Fine copper content of matte	15,200,000	22,881,936	[a] 11,000,000	[a] 5,420,000	[a] 3,500,000
Total	136,528,390	282,105,860	288,662,340	321,023,873	252,876,480
Available supply	258,701,237	195,252,842	233,994,354	279,405,581	411,512,781

Source.	1900.	1901.	1902.	1903.	1904.
Production of domestic copper	606,117,166	602,072,519	659,508,644	698,044,517	812,537,267
Imports:					
Fine copper in ore and matte, entered for consumption	[a] 36,380,000	[a] 64,000,000	[d] 40,000,000	[a] 32,000,000	38,947,772
Bars, ingots, and old copper	68,796,808	73,826,406	103,129,568	136,707,995	142,344,433
Total	711,293,974	739,898,925	802,638,212	866,752,512	993,829,472
Exports:					
Ingots and bars—					
Domestic	338,121,071	194,249,828	354,668,849	310,729,524	554,549,880
Foreign	1,281,782	12,888,083	11,629,877	2,093,103	1,088,672
Fine copper content of matte	[a] 9,000,000	[a] 15,000,000	[a] 11,000,000	[a] 7,500,000	[a] 12,000,000
Total	348,402,853	222,137,911	377,298,726	320,322,627	567,638,552
Available supply	362,891,121	517,761,014	425,339,486	546,429,885	426,190,920

[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 two leading producers of the Lake district, have submitted a statement of the stock of metal, the blanks calling for stock at works, in transit, or in agents' hands, exclusive of material in course of conversion at the works, but inclusive of converter bars, matte, etc., which must be shipped for further treatment. The stocks do not include the quantities 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.

Producers who made 586,409,153 pounds of the total output of copper in 1904 had on hand on January 1, 1905, 119,215,597 pounds of copper, as compared with 175,073,531 pounds on January 1, 1904, thus indicating that stocks were drawn upon during 1904 to the extent of 55,857,934 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, 1903, and 1904 being as follows:

Estimated consumption of copper in the United States in 1900, 1901, 1902, 1903, and 1904.

[Pounds.]

	1900.	1901.	1902.	1903.	1904.
Available supply	362,891,121	517,761,014	425,339,486	546,429,885	426,190,920
Deduct increase in producers' stocks.	6,000,000	135,000,000		20,000,000	
Add decrease in producers' stocks			126,348,645		56,000,000
Estimated consumption	356,891,121	382,761,014	551,688,131	526,429,885	482,190,920

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, 1860–1895, by years.

[Cents per pound.]

Year.	Highest.	Lowest.	Year.	Highest.	Lowest.
1860	24	$19\frac{3}{4}$	1878	$17\frac{5}{8}$	$15\frac{1}{2}$
1861	27	$17\frac{1}{2}$	1879	$21\frac{3}{4}$	$15\frac{1}{2}$
1862	$32\frac{7}{8}$	$20\frac{3}{4}$	1880	25	$18\frac{1}{2}$
1863	$38\frac{1}{2}$	29	1881	$20\frac{3}{8}$	16
1864	25	39	1882	$20\frac{3}{8}$	$17\frac{7}{8}$
1865	$50\frac{1}{2}$	28	1883	$18\frac{1}{8}$	$14\frac{7}{8}$
1866	42	$26\frac{1}{2}$	1884	15	11
1867	$29\frac{1}{4}$	$21\frac{1}{2}$	1885	$11\frac{1}{2}$	$9\frac{4}{5}$
1868	$24\frac{1}{2}$	$21\frac{1}{2}$	1886	$12\frac{1}{8}$	10
1869	$26\frac{1}{2}$	$21\frac{7}{8}$	1887	$17\frac{3}{4}$	$9\frac{19}{20}$
1870	$23\frac{3}{8}$	19	1888	$17\frac{4}{10}$	$15\frac{17}{20}$
1871	27	$21\frac{1}{4}$	1889	$17\frac{1}{2}$	11
1872	44	$27\frac{1}{8}$	1890	$17\frac{1}{4}$	14
1873	35	21	1891	15	$10\frac{1}{4}$
1874	25	19	1892	$12\frac{3}{8}$	$10\frac{1}{2}$
1875	$23\frac{7}{8}$	$21\frac{1}{2}$	1893	$12\frac{1}{2}$	$9\frac{3}{5}$
1876	$23\frac{1}{4}$	$18\frac{3}{4}$	1894	$10\frac{1}{4}$	9
1877	$20\frac{1}{2}$	$17\frac{1}{2}$	1895	$12\frac{3}{4}$	$9\frac{1}{4}$

The following table shows the fluctuations in prices in the English market:

Average value of copper in England, 1897–1904.

[Per long ton.]

Year.	Standard copper.			Best selected copper.		
	£	s.	d.	£	s.	d.
1897	49	2	6¾	52	5	2
1898	51	16	7¼	55	8	10
1899	73	13	8½	78	2	0
1900	73	12	6¼	78	8	9
1901	66	19	8¼	73	8	8
1902	52	11	5½	56	12	7
1903	58	3	2	62	14	7¾
1904	59	0	6½	62	12	1½

The following table shows the highest and lowest prices, monthly, during the last nine years:

Highest and lowest prices of Lake Superior ingot copper, by months, 1896–1904.

[Cents per pound.]

Year.	January.		February.		March.		April.		May.		June.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1896	10¼	9¾	11¼	10	11½	10⅞	11	10¾	11½	10⅞	11¾	11½
1897	12	11½	12	11⅞	11⅞	11½	11½	11	11⅛	10¾	11⅛	10⅞
1898	11	10 9/10	11¾	11	12	11⅞	12⅛	11⅞	12⅛	12	11⅞	11¾
1899	17	13¼	18	17	18	17	19½	18	19¼	18½	18½	18
1900	16½	16¼	16½	16	17	16¼	17¼	17	17¼	16½	16½	16¼
1901	17	16¾	17	16⅞	17	16⅞	17	17	17	16⅞	17	16⅞
1902	13	10⅞	13¼	12	12½	12⅛	12¼	12	12¾	12	12¾	12¼
1903	12½	12	13⅜	12½	14⅞	13½	15	14¾	14¾	14⅝	14¾	14¼
1904	12¾	12¼	12⅛	12¼	13	12½	13⅝	13	13⅜	12⅞	13⅛	12½

Year.	July.		August.		September.		October.		November.		December.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1896	11¾	11	11⅛	10⅞	10⅞	10⅜	10⅞	10½	11½	10⅞	11½	11¼
1897	11⅛	11	11¼	11	11⅜	11¼	11¼	11	11	10¾	11	10⅞
1898	11¾	11½	12⅛	11⅜	12¼	12⅛	12½	12¼	12¾	12½	12⅞	12⅝
1899	18½	18¼	18½	18¼	18½	18¼	18½	17	17¼	17	17	16½
1900	16½	16⅛	16¾	16½	16⅞	16¾	16⅞	16¾	17	16¾	17	16¾
1901	17	16⅜	16¾	16½	16¾	16½	16⅞	16½	16¾	16¼	16½	12⅞
1902	12⅛	12	12⅛	11⅝	12	11¾	12¼	11¾	12	11½	12⅛	11½
1903	14¼	13	13⅞	13	13½	13⅜	14	12¾	14	12½	12½	11¾
1904	12⅞	12⅝	12¾	12⅝	13	12¾	14	12⅞	15¼	13⅞	15¼	14⅞

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, 1903, and 1904:

Average selling prices of Lake copper in 1902, 1903, and 1904.

Mine.	1902.		1903.		1904.	
	Quantity sold.	Average price per pound.	Quantity sold.	Average price per pound.	Quantity sold.	Average price per pound.
	Pounds.	*Cents.*	*Pounds.*	*Cents.*	*Pounds.*	*Cents.*
Tamarack	15,961,528	11.87	15,286,093	13.02	14,961,885	13.24
Osceola	13,416,396	11.78	16,059,636	13.00	20,472,429	13.19
Atlantic	4,949,366	11.88	5,505,578	13.12	5,321,859	13.34
Isle Royale	3,569,748	11.91	3,134,601	13.12	2,442,905	13.19
Baltic	6,285,819	11.87	10,580,997	13.43	12,177,729	12.99
Champion			10,564,147	13.37	12,212,954	13.03
Trimountain			9,237,051	13.43	10,211,230	13.67
Winona			1,039,944	13.49	642,025	13.66
Quincy			18,498,288	13.24	18,343,160	13.48
Franklin			4,712,388	13.72		
General average		11.86		13.26		13.21

THE COPPER MARKET IN 1904.

The year 1904 opened with a steady market at the range of 12¼ to 12½ cents for Lake and 12⅛ to 12⅜ cents for electrolytic. Free buying on the part of home consumers and for export created an upward tendency until 13 cents was reached in the middle of January. A downward tendency then developed, which continued during February. Lake copper receding to 12¼ cents, and electrolytic touching 12 cents. This was due largely to the declaration of war in the Far East and to uneasiness in financial circles. Foreign interests bought more freely than the home trade, and when the latter entered the market toward the middle of March values recovered to 13 cents for Lake copper and 12⅞ cents for electrolytic copper. Activity continued during April, and prices rose to 13⅝ cents for Lake; but this activity was followed by dullness and lower prices in May and in early June. Then large sales were made for export and to domestic consumers on the basis of 12½ cents for Lake and 12⅜ cents for electrolytic copper. The market was steady and fairly active in July, August, and September. A considerable speculative interest developed in September with heavy buying on the part of foreign and domestic consumers, which extended well into October. Prices advanced steadily until they reached 14 cents for Lake copper. The latter half of November brought a further advance to 15 cents and upward for Lake copper. In the early half of December some speculative lots of electrolytic copper were forced upon the market at as low as 14½ cents, and the break in leading copper mining shares on the stock exchange unsettled the market. The year closed, however, with confidence largely restored, and with some heavy buying for both sides of the Atlantic.

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, 1890–1904.

[Long tons.]

Year.	Imports of—		Total imports.	Exports.	Apparent English consumption.
	Bars, cakes, and ingots.	Copper in ores and furnace products.			
1890	[a] 49,461	91,788	141,249	89,747	66,170
1891	44,213	94,403	138,616	76,056	59,223
1892	[b] 35,015	99,356	134,371	82,542	[c] 48,367
1893	41,829	88,003	129,832	70,986	66,817
1894	56,157	68,851	125,008	54,689	[d] 50,330
1895	42,135	77,806	119,941	65,990	[d] 50,692
1896	60,458	75,398	135,856	59,334	[d] 76,036
1897	60,428	76,127	136,555	56,542	[d] 69,787
1898	67,978	71,726	139,704	63,370	[d] 69,284
1899	58,880	82,730	141,610	75,271	[d] 60,877
1900	70,247	84,694	154,941	56,997	[d] 81,896
1901	66,764	82,814	149,578	70,396	[d] 70,178
1902	90,022	70,179	160,201	69,156	[d] 80,223
1903	62,879	70,047	132,926	76,305	[d] 56,621
1904	88,282	69,615	157,897	73,447	[d] 55,886

[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, 10,822 tons in 1902, 13,361 tons in 1903, and 17,561 tons in 1904).

The following figures for the years from 1896 to 1904, 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, 1896–1904.

[Long tons.]

Character.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Pure in pyrites	14,726	15,576	16,626	17,529	18,519	16,339	15,279	18,398	18,571
Pure in precipitate	23,160	25,932	21,558	24,387	23,462	22,037	17,874	18,216	18,229
Pure in ore	12,499	11,980	14,576	19,514	17,886	16,683	15,038	14,649	14,529
Pure in matte	25,013	22,639	18,966	21,300	24,827	27,755	21,988	22,784	18,286
Bars, cakes, etc	60,458	60,428	67,978	58,880	70,247	66,764	90,022	62,879	88,282
Total	135,856	136,555	139,704	141,610	154,941	149,578	160,201	136,926	157,897

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, 1897–1904.

[Long tons.]

Country.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Chile	14,982	17,734	19,752	19,875	24,624	23,789	20,968	22,655
United States	32,792	38,979	20,773	32,256	21,426	43,632	19,255	47,663
Spain and Portugal	7,697	7,293	7,084	9,721	7,780	7,860	8,189	8,329
Spain and Portugal (precipitate)	17,386	15,664	16,847	17,028	16,354	13,592	12,998	12,691
Spain and Portugal (pyrites)	15,576	16,626	17,529	18,519	16,339	15,279	18,398	18,571
Australasia	10,218	13,409	17,085	19,977	20,586	26,261	21,848	18,937
Cape of Good Hope	7,575	9,381	7,076	8,927	8,284	6,050	7,891	9,803
Venezuela	21							
Japan	3,654	2,086	7,812	6,763	7,820	5,331	5,748	3,218
Italy	100	177	157	119	20		110	
Norway	130		182	679	728	523	622	440
Canada	127		10	25		431		
Newfoundland	2,484	1,359	2,044	1,589	1,669	1,100	1,286	1,208
Mexico	6,217	4,888	5,679	8,781	8,268	7,945	9,681	7,465
Peru	998	3,041	5,163	8,220	9,512	7,580	7,797	6,754
Plata River	190	124	63	73	84	242	134	153
Africa								250
Other countries	1,613	1,807	8,232	3,633	4,756	1,289	2,850	1,607
Total tons fine	121,760	132,568	135,488	156,185	148,250	160,904	137,775	159,744

It will be observed that the imports from the United States reached a record figure, having more than doubled as compared with 1903.

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, 1891–1904.

[Long tons.]

Country.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
England:							
Ore	4	18	23	5			
Matte	19,109	24,668	20,700	2,133	8,337	10,016	5,259
Bars and ingots	7,007	1,427	14,924	28,357	12,250	29,780	27,591
Total	26,120	26,113	35,647	30,495	20,587	39,796	32,850
France	8,329	4,340	12,483	9,248	11,806	21,998	26,165
United States into England and France	34,449	30,453	48,130	39,743	32,393	61,794	59,015

Imports of copper into England and France from the United States, 1891-1904—Cont'd.

Country.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
England:							
Matte	2,181	354	2,767	6,299	2,899	148	22
Bars and ingots	36,790	20,739	29,267	15,112	40,733	19,080	47,621
Total	38,971	21,093	32,034	21,411	43,632	19,228	47,643
France	22,753	24,695	29,100	14,008	29,455	23,961	44,212
United States into England and France	61,724	45,788	61,134	35,419	73,087	43,189	91,855

The export to Europe of ores and matte from this country has now practically ceased, so that the statistics bearing on this point have ceased to be of value. At one time they were important in order to trace the copper content of furnace material concerning which direct data were missing in our own official export statistics.

THE GERMAN COPPER TRADE.

Next to the United States, Germany has now become by far the greatest consumer of copper. In less than ten years the consumption has practically doubled, and it showed an extraordinary expansion in 1904. Very elaborate and careful statistics are annually compiled by Aron Hirsch & Sohn, of Halberstadt. The following table presents a general summary:

Copper consumption of Germany, 1898-1904.

[Metric tons.]

	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Importations:							
Fine copper	73,290	70,094	83,502	58,620	76,049	83,260	110,231
Old copper, coin, brass, and ores.	16,482	19,652	23,118	19,918	21,200	23,527	24,741
Total imports	89,772	89,746	106,620	78,538	97,249	106,787	134,972
Exports	14,957	20,304	15,618	14,825	13,571	14,618	14,343
Excess of imports	74,815	69,442	91,002	63,713	83,678	92,169	120,629
Production	30,704	37,676	32,423	31,572	30,728	31,446	31,377
Available copper	105,519	107,118	123,425	95,285	114,406	123,615	152,006
Deduct contents of imported ores and pyrites	4,000	4,500	6,500	5,500	5,500	6,000	6,000
Home consumption	101,519	102,618	116,900	89,785	108,906	117,615	146,006
Imports of manufactures	2,449	2,811	3,073	2,680	2,870	3,261	3,473
Exports of manufactures	36,999	40,175	46,939	42,240	45,261	61,272	64,085

For a series of years the German Government has taken pains to trace to its source, geographically, the fine copper imported, thus avoiding the uncertainties growing out of the method of entering Holland and Belgium as countries of destination in the export statistics of such countries as the United States and Great Britain. With the aid of the German statistics we know how much of the copper sent to Holland and Belgium really reaches Germany and what copper shipped to German ports, in transit, is retained in that country.

The official statistics show that the fine copper imported into Germany came from the following countries:

Principal sources of supply of copper for Germany, 1898–1904, by countries.

[Metric tons.]

Country.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
United States	52,151	47,742	66,264	42,422	60,274	64,072	98,417
Free port	2,873	2,496	2,222	1,899	1,598	1,662	1,638
Belgium	216	19	177	29	162	268	318
France	121	93	87	149	49	193	182
Norway	32	1	11	9	35	7	45
Austria	12	105	224	124	141	346	101
Sweden	328	215	161	10	268	233	1
Switzerland	2	1	1	6	......	......	......
Spain	69	31	446	1,164	868	1,601	1,175
England	12,754	14,350	9,545	7,653	8,536	10,390	6,273
Netherlands	19	184	216	34	152	66	124
Japan	2,196	3,050	2,377	3,158	2,493	3,130	636
Chile	1,216	1,187	1,016	931	886	398	320
Australia	742	581	593	948	493	826	716
Other countries	25	39	162	84	94	68	285
Total	72,756	70,094	83,502	58,620	76,049	83,260	110,231

It is probable, of course, that some of the copper coming from England is in reality the product of this country. On the other hand, some Mexican copper may be credited to this country.

Aron Hirsch & Sohn have for some years estimated the sources of copper consumption, and have reached the following figures:

Consumption by manufacturers' requirements, 1900–1904.

[Metric tons.]

Use specified.	1900.	1901.	1902.	1903.	1904.
Electrical works	43,000	26,000	37,000	46,000	59,000
Copper rolling mills (rods and sheets)	18,000	16,000	18,000	18,000	23,000
Brass rolling mills and wire works	35,000	29,000	32,000	32,500	37,000
Chemical works and blue vitriol	2,000	2,000	2,000	2,000	2,000
Shipyards, railroads, for castings, alloys, German silver, etc	19,000	17,000	19,000	18,500	25,000
Total	117,000	90,000	108,000	117,000	146,000

The revival of the electrical industry, after the depression of 1901, is most noteworthy.

Aron Hirsch & Sohn have tabulated their estimates of consumption in the leading countries. After substituting for their figures for the United States the data collected by this office, the figures are as follows:

Consumption of copper in leading countries, 1901–1904, by countries.

[Long and metric tons.]

Country.	1901.	1902.	1903.	1904.
United States	170,880	246,290	236,800	215,264
Germany	89,548	108,906	116,318	146,006
England	107,021	121,877	110,766	133,280
France	47,180	55,550	52,789	64,234
Austria-Hungary	19,917	20,940	21,122	26,366
Russia	17,459	25,475	24,633	29,624
Italy	8,928	10,521	10,987	18,162
European countries	9,000	10,000	11,000	13,500
Asia	17,000	17,000	17,000	38,175
Total	486,933	616,559	601,415	684,611
Production	517,865	548,604	585,461	648,924

It is worthy of note that nearly every country participated in the improvement in the consumption during 1902, when the maximum was reached in this country, and that the leading European countries far exceeded the 1902 record in 1904.

LEAD.

By Charles Kirchhoff.

INTRODUCTION.

With a largely increased production, and an even greater increase in the consumption, coupled with a fair level of prices, the lead mining and smelting industry of the United States enjoyed a prosperous year in 1904. It was characterized by a further tendency toward consolidation of interests.

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, 1825–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
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	282,000
1847	28,000	1866	16,100	1885	129,412	1904	307,000

While it is possible to arrive with a satisfactory degree of accuracy at the lead contents of the ores mined in some of the more important districts and States, it is quite impracticable to trace to their source, through direct returns from the mines, the lead contents of ores from many other scattered producing sections. Thus, the lead production of the Coeur d'Alene district, and therefore practically that of Idaho, may be readily ascertained. The lead production of the Mississippi Valley is easily arrived at, but complete figures for the other States and Territories could not be obtained except by a very laborious census, which it is not deemed advisable to undertake when a much simpler and equally accurate method is available—a method which has been successfully employed for many years. Through the courtesy of all the smelting works in the United States statistics have been available showing the source, geographically, of the lead in the ores treated by them. These furnish the basis for an estimate of the total lead produced from ores mined in the United States, which is arrived at by making an allowance for the loss in smelting, desilverizing, and refining. They furnish also a means of estimating the lead product of the different States and Territories and for gaging the progress or the decline of different sections as producers of the metal. They are really mining statistics, expressed by metal contents, since the figures of the tonnage of ore have no significance in view of the great variations in the metal contents.

These statistics of production, whose primary object is to show how much lead was obtained from the mines of the United States and from what sources, geographically, it was drawn, do not necessarily agree with the commercial statistics. Some time elapses before the lead produced by smelters of argentiferous furnace mixtures is desilverized and refined ready to be marketed. Then, too, very important quantities of lead figure in the commercial statistics in addition to the metal derived from ores mined in the United States. Large quantities of foreign ores are smelted in American works. Very much larger quantities of foreign base bullion are desilverized and refined in American plants. This is done in bond, and only a part of the metal thus obtained is exported.

It is not safe to attempt to arrive at the lead product of the mines of the United States by deducting from the total production of refined lead made by smelters and refiners the quantities obtained from handling foreign material, because the lead contents of the foreign ores have not always been closely known, and because the figures so obtained represent data at the end of a series of operations, and are, in the matter of time, too distant from the actual mining operations, with intervening fluctuations in the quantity of metal in process of manufacture and transit. Then, too, the advantage of being able to apportion the product, approximately, by States and Territories, is surrendered.

The method, however, does furnish a welcome check upon the direct method adopted by this office.

The returns of all the smelters in the United States aggregate as follows:

Lead content of ores smelted by the works in the United States, 1894–1904, by States.

[Short tons.]

State or Territory.	1894.	1895.	1896.	1897.	1898.
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	170,388	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	344	428

State or Territory.	1899.	1900.	1901.	1902.	1903.	1904.
Colorado	70,308	82,137	73,265	51,833	45,554	51,884
Idaho	52,154	85,444	79,654	84,742	99,590	108,854
Utah	29,987	48,044	49,870	53,914	51,129	56,470
Montana	10,227	....	5,791	4,438	3,303	3,635
New Mexico	4,856	....	1,124	741	613	1,363
Nevada	3,388	....	1,873	1,269	2,237	1,873
Arizona	3,377	....	4,045	599	1,493	1,499
California	487	520	381	175	55	163
Washington	862	....	1,029	1,457	538	622
Oregon, Alaska, South Dakota, Texas				2,184	1,765	41
Missouri, Kansas, Wisconsin, Illinois, Iowa, Virginia, and Kentucky	54,444	....	67,172	79,445	86,597	92,275
Total lead content American ores smelted	230,090	....	284,204	280,797	292,874	318,679
Content Mexican ores	10,293	....	11,841	8,755	56,890	24,952
Content Canadian ores	5,110	....	9,615	2,164	253	11
Content miscellaneous or unknown	772	....	804	3,975	2,831	1,113

a Estimated.

The yield in merchant pig lead of the contents of the ores smelted, after undergoing the smelting, desilverizing, and refining operations, is estimated at 95 per cent.

The figure for the lead contents of the ores of the Mississippi Valley and of the Southern States is a total of two returns. It represents the pig lead produced by smelters in Missouri, Kansas, Wisconsin, and

Iowa, usually known as soft lead, from nonargentiferous ores, and the lead contents of the ores from both districts purchased and smelted by works which handle argentiferous ores, and which, therefore, divert the metal into the desilverized or hard lead. For the year 1904 this total of 92,275 short tons embraced 89,169 short tons of pig lead smelted directly by nonargentiferous smelters and 3,106 tons of lead contents of Mississippi Valley and Southern ores smelted by desilverizing plants.

In calculating the yield of lead, the allowance of 95 per cent does not, therefore, apply to the total of 318,679 tons in the table, but to a quantity less by 89,169 tons of merchant pig lead, or to 229,510 tons. Of this latter quantity, 95 per cent, or 218,035 short tons, may be estimated as the merchant lead product of the lead contained in the ores mined in the United States during 1904. Adding the 89,169 tons of soft lead directly produced in the Mississippi Valley, a total is reached of 307,204 short tons. In order to indicate that it is an approximation, the rounded figure of 307,000 tons is accepted as representing the lead production of the United States from domestic ores for the year 1904.

Redistributing this total pro rata among the States and Territories which yielded plumbiferous ores in 1904, the following figures are reached as the probable production of merchant lead assignable to each, compared with 1903:

Production of merchant lead, by States, 1903 and 1904.

[Short tons.]

State or Territory.	1903.	1904.
Colorado	43,276	49,290
Idaho	94,611	103,411
Utah	48,573	53,647
Montana	3,138	3,454
Nevada	2,125	1,779
New Mexico	582	1,295
Arizona	1,418	1,424
California	52	155
Washington	511	591
Alaska, Oregon, South Dakota, etc	1,677	39
Mississippi Valley and Southern States	86,439	92,119
Total	282,402	307,204

It will be observed that Idaho produced one-third of the total, followed by the Mississippi Valley, which, too, increased its output, the Southern States figuring in this total for a very small amount. Colorado and Utah together contributed a further third to the lead production.

PRODUCTION OF PIG LEAD FROM ALL SOURCES.

In 1886 there began in the United States the treatment of foreign ores and of foreign base bullion, largely drawn from Mexico, which reached very large proportions in 1897 and subsequent years. A large part of this metal is smelted or refined in bond, and is exported; but a certain tonnage is imported for domestic consumption and some lead is brought in as "exempt" lead without paying a duty. This has a very considerable influence upon the commercial statistics of the metal.

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, 1883–1904.

[Short tons.]

Year.	Total production.[a]	Desilverized lead.[a]	Soft lead.[b]	From foreign ores and base bullion.
1883	143,957	122,157	21,800	....
1884	139,897	119,965	19,932	....
1885	129,412	107,437	21,975	....
1886	135,629	114,829	20,800	[c] 5,000
1887	160,700	135,552	25,148	[c] 15,000
1888	180,555	151,465	29,090	28,636
1889	182,967	153,709	29,258	26,570
1890	161,754	130,403	31,351	18,124
1891	202,406	171,009	31,397	23,852
1892	213,262	181,584	31,678	39,957
1893	229,333	196,820	32,513	65,351
1894	219,090	181,404	37,686	59,739
1895	241,882	201,992	39,890	76,173
1896	264,994	221,457	43,537	77,738
1897	291,036	247,483	43,553	83,671
1898	310,621	267,842	42,779	99,945
1899	304,392	263,826	40,566	95,926
1900	377,679	329,658	48,021	106,855
1901	381,688	323,790	57,898	112,422
1902	377,061	303,011	74,050	100,606
1903	378,518	295,074	83,444	88,324
1904	404,453	315,284	89,169	95,850

[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, to 9,579 tons in 1903, and to 11,001 tons in 1904.

The imports from foreign countries, according to the direct returns from the smelters and refiners, consisted of 69,774 short tons of base bullion and 26,076 tons of lead in ores, equivalent to about 92,500 tons of lead. Deducting this from the total product of 404,453 tons would leave about 312,000 tons as from domestic sources, which is slightly higher than the figure reached upon the basis of the lead smelters' direct returns.

DOMESTIC PRODUCERS.

In the Mississippi Valley a considerable increase in the production took place in 1904 and is still in progress. In the lead-zinc regions of southwest Missouri and southeast Kansas the production of lead approached the record of 1901. According to local statisticians, the sales of lead ore, obtained in mining zinc ores, the chief mineral of value, amounted in 1904 to 34,530 short tons, valued at $1,898,196, as compared with 28,530 tons in 1903, 30,142 tons in 1902, and 34,908 tons in 1901. The principal producing camps were Webb City-Carterville, with sales of 16,508 tons of concentrates; Joplin, with 8,732 tons; Galena, with 3,546 tons; Duenweg, with 1,480 tons, and Granby, with 1,249 tons. The greater part of this ore is smelted by local smelters, the Picher Lead Company, the Galena Smelting and Manufacturing Company, and the Granby Mining and Smelting Company, which in 1904 produced 19,581 short tons of pig lead, as compared with 17,343 tons in 1903, 18,628 tons in 1902, and 15,464 tons in 1901. For the first time, however, in the history of the district, one of the smelters, the Picher Company, treated ores from a distant source, since it handled some Idaho product. A certain quantity of the lead ore of the district is converted directly into pigment.

In southeast Missouri further progress has been made by an increased activity among the old established mines. The St. Joseph Lead Company, the largest individual producer of lead in the country, has gained in output by enlarging the old Bonne Terre mill, by putting into partial operation a new mill at the Hoffman shaft which will be capable of handling 1,000 short tons of ore per day, and by adding to the smelting facilities at the Herculaneum works. The Doe Run Company, which is closely allied with the St. Joseph Lead Company, has operated to full capacity. The Desloge Lead Company has sunk a new shaft, and has increased its mill capacity 50 per cent. This company smelts only a part of its product, selling the remainder. The Central Lead Company produced 3,812 short tons of lead in 1904, as compared with 5,536 tons in 1903, the falling off being due to the fact that the mines and works were idle for three months as the result of a strike inaugurated in order to force a recognition of the first miners' union organized in the district. The effort failed. The Central Lead Company has been sold to the American Smelters' Securities Company. The National Lead Company now ships the product of its Derby mines to the new smelter at Collinsville, Ill., which went into operation during 1904. The Federal Lead Company produces considerable quantities of ore and smelts largely of ores on toll. The Mine la Motte Company did not produce as largely in 1904 as in previous years. The old Shibboleth Lead Mining Company, of Cadet, Mo., has passed into the hands of the American Lead and Baryta Company.

The St. Joseph, Doe Run, Desloge, Central, and Mine la Motte companies produced at their own smelters 42,468 short tons in 1904, as compared with 41,726 tons in 1903, 41,192 tons in 1902, and 35,132 tons in 1901. The smelters of the St. Louis district, which treat nearly all the remainder of the southeast Missouri ores, produced in 1904, 25,503 short tons of pig lead, as compared with 23,475 tons in 1903.

The Coeur d'Alene district, in Idaho, is the most important single lead producing district in the United States. The returns to this office from the smelting works show the lead contents of the Idaho mines—which is practically the Coeur d'Alene district—to have been 108,854 short tons. The report of the State mine inspector places the lead contents of the output of the Coeur d'Alene mines for 1904 at 108,964 short tons of lead and 5,947,326 ounces of silver, the yield of the principal mines having been 47,150 tons of lead and 3,032,000 ounces of silver for the Federal group, 30,718 tons of lead and 1,094,100 ounces of silver for the Bunker Hill and Sullivan, 14,942 tons of lead and 507,353 ounces of silver for the Morning mine, 7,000 tons of lead and 900,000 ounces of silver for the Hercules mine, and 7,539 tons of lead and 447,924 ounces of silver for the Hecla mine. The Federal Mining and Smelting Company controls the Wardner group of mines, formerly belonging to the Empire State-Idaho Company; the Mace group, formerly owned in part by the Standard Company and in part constituting the Mammoth group; and the Burke group, formerly the Tiger-Poorman group. An estimate made in the fall of 1904 places the quantity of ore in sight at the Wardner group at 200,000 tons, at the Burke mines at 180,000 tons, and at the Mace mines at 1,200,000 tons. The first annual report of the company for the year ending August 31, 1904, showed that the ore shipped was valued at $4,908,926, which yielded a gross profit of $1,690,524. Among the costs were $1,056,207 for mine labor, $103,399 for mill labor, and $1,615,573 for freight and treatment charges. There were deducted from the gross profit $219,625 for general and administration expenses, and $629,309 were paid in dividends. The annual report of the Bunker Hill and Sullivan Mining and Concentrating Company for the year ending May 31, 1904, furnishes some interesting data. The mines produced 286,208 short tons of concentrating ore and shipped 2,505 tons of crude ore, a total of 288,713 tons, the average cost of which was $1.563 per ton. Tramming cost 7 cents per ton and concentrating 20.2 cents per ton. The shipments to the smelters amounted to 39,556 tons of concentrates and crude ore. The total cost at the mine per ton of ore mined was $1.976 per ton, and per ton shipped it was $14.124, the total operating costs being $570,288. The freight and treatment charges were $803,012, the value of the ore mined being $1,964,778. After paying for taxes, improvements, etc., there remained a balance of $521,972, out of which dividends aggregating $309,000 were paid. The mines had in reserve partially blocked out 1,350,463 tons of ore.

In Colorado, Leadville continues to be the principal lead-producing camp. It is estimated that the lead contents of the ores shipped from Lake County amounted to 21,651 short tons. Fresh discoveries at Leadville hold out the promise of a considerable increase in the production. Pitkin County is estimated to have shipped ores carrying about 9,000 tons of lead, followed by Mineral County with 6,600 tons, and San Juan County with 4,700 tons.

Utah has increased its output by enlarged operations in the Tintic district, where the Centennial-Eureka, Gemini, Grand Central, and Mammoth are the principal shippers. At Park City the Daly-Urst and the Silver King are the leading producers. The United States Smelting Company has completed a new lead-smelting plant at Bingham Junction.

SMELTING AND REFINING IN BOND.

The records of the Bureau of Statistics of the Department of Commerce and Labor make the following exhibit of the warehouse transactions in lead during recent years. This covers the smelting and refining of lead in bond:

Official returns of warehouse transactions in lead during 1901, 1902, 1903, and 1904.

[Pounds.]

	1901.	1902.	1903.	1904.
In warehouse at beginning of year	42,379,270	33,225,677	47,817,806	21,387,901
Direct importation	221,030,779	200,571,318	197,813,008	206,141,784
	263,410,049	233,796,995	245,630,814	227,529,685
Deduct in warehouse at end of year	33,225,677	47,817,806	21,387,901	22,962,984
	230,184,372	185,979,189	224,242,913	204,566,701
Addition by liquidation	592,977	253,875	1,771,740	998,687
Total	230,777,349	186,233,064	226,014,653	205,565,388

The disposition of this was as follows:

Disposition of lead in warehouses in 1901, 1902, 1903, and 1904.

[Pounds.]

	1901.	1902.	1903.	1904.
Exported	194,199,419	157,834,807	163,774,605	167,181,377
Withdrawn for consumption	16,035,929	14,084,741	40,074,153	18,736,130
Deducted by liquidation	23,373,544	60,245,134	32,164,525	22,962,984
Total	233,608,892	232,164,682	236,013,283	208,880,491

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, 1890–1904.

[Pounds.]

Year ending December 31—	Ore and dross.		Pigs and bars.	
	Quantity.	Value.	Quantity.	Value.
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
1904	19,015,540	328,279	17,334,033	480,823

Year ending December 31—	Sheets, pipe, and shot.		Not otherwise specified.	Total value.
	Quantity.	Value.		
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	973,662
1904	69,581	2,441	5,277	816,820

Lead, and manufactures of lead, of domestic production, exported, 1890-1904.

[Pounds.]

Year ending December 31—	Manufactures of lead.		Pigs, bars, and old.		Total value.
	Quantity.	Value.	Quantity.	Value.	
1890		$181,030			$181,030
1891		173,887			173,887
1892		154,375			154,375
1893		508,090			508,090
1894		456,753		[a] $41,240	497,993
1895		164,083	1,696,879	50,773	214,856
1896		164,877	[b] 16,359,452	442,496	607,373
1897	[c] 150,473	[d] 49,816	[b] 7,725,624	223,037	433,319
		[e] 160,466			
1898	[c] 265,062	[d] 97,862	118,960	4,450	215,239
		[e] 112,927			
1899	[c] 314,348	[d] 115,137	93,115	4,286	273,919
		[e] 154,496			
1900	[c] 363,600	[d] 130,758	1,993,773	88,664	459,571
		[e] 240,149			
1901	[c] 490,460	[d] 178,752	4,787,107	214,842	624,534
		[e] 230,940			
1902	[c] 454,423	[d] 153,309	6,542,760	286,548	696,010
		[e] 256,153			
1903	[c] 364,220	[d] 127,530	112,544	6,210	491,362
		[e] 357,622			
1904	[c] 439,953	[d] 160,863	70,408	3,478	616,126
		[e] 451,785			

[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 from 1895 to 1904, inclusive, were as follows:

Sources of imports of lead.

[Pounds.]

Country.	1895.	1896.	1897.	1898.	1899.
United Kingdom	8,161,411	1,365,132	1,120,528	2,326,937	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	2,326,937	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.

[Pounds.]

Country.	1900.	1901.	1902.	1903.	1904.
United Kingdom	567,482	402,552	792,607	1,552,772	494,556
Germany	225,222	671,294	952,878	1,409,926	731,222
Other Europe	111,905	2,453	1,342,193	451,331	165,661
Total refined pig lead	904,609	1,076,299	3,087,678	3,414,029	1,391,439
British North America	42,139,262	52,130,002	19,464,937	19,200,806	17,903,798
Mexico	178,602,486	163,453,526	187,484,666	186,136,779	205,805,911
Total ore and base bullion	220,741,748	215,583,528	206,949,603	205,337,585	223,709,709
Other countries	7,147,092	8,282,502	5,195,174	4,061,872	602,164
Total imports	228,793,449	224,942,329	215,232,455	212,813,486	225,703,312

CONSUMPTION.

Upon the basis of the data available the following estimates are presented for the consumption of lead for a series of years. Complete reports of the stocks of lead on hand have not been available for 1904.

Estimate of the consumption of lead in the United States, 1895–1904.

[Short tons.]

	1895.	1896.	1897.	1898.	1899.
Supply—					
Total production desilverized lead	201,992	221,457	247,483	267,827	263,826
Soft lead	39,890	43,537	43,553	42,779	40,566
Imports, foreign refined	22,947	2,020	2,000	437	215
Stock, domestic, beginning of year	8,586	9,557	9,299	17,608	....
Stock, foreign in bond, beginning of year	7,181	9,865	4,124	6,691	7,341
Total supply	280,596	286,436	306,459	335,342	311,948
Deduct—					
Foreign base bullion and ores refined in bond and exported	18,130	57,612	62,409	84,666	73,313
Lead in manufactures exported under drawback	2,000	1,500	500	1,200	1,000
Stock, domestic, close of year	9,557	9,299	17,608	14,683	....
Stock, foreign in bond[a]	9,865	4,124	6,694	7,341	11,320
Total	39,552	72,535	87,211	107,890	85,633
Apparent home consumption	241,044	213,901	219,248	227,452	226,315

Estimate of the consumption of lead in the United States, 1895-1904—Continued.

[Short tons.]

	1900.	1901.	1902.	1903.	1904.
Supply—					
Total production desilverized lead	329,658	323,790	303,011	295,074	315,284
Soft lead	48,021	57,898	74,050	83,444	89,169
Imports, foreign refined	452	538	1,544	1,707	696
Stock, domestic, beginning of year	....	39,050	53,733	11,595	....
Stock, foreign in bond, beginning of year[a]	11,320	21,190	16,613	23,909	10,694
Total supply	389,451	442,466	448,951	415,729	415,843
Deduct—					
Foreign base bullion and ores refined in bond and exported	97,959	97,100	76,962	90,353	79,596
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]	21,190	16,613	23,909	10,694	11,481
Total	120,149	168,446	113,466	111,246	92,077
Apparent home consumption	269,302	274,020	335,485	304,483	323,766

[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.

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, 1890-1904.

[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
1904	4.50	4.25	4.50	4.40	4.60	4.50	4.60	4.50

Highest and lowest prices of lead in New York City, monthly, 1890-1904—Continued.

[Cents per pound.]

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
1904	4.50	4.25	4.35	4.20	4.30	4.10	4.20	4.10

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
1904	4.25	4.20	4.30	4.20	4.50	4.20	4.65	4.60

During the whole of the year, the lead market was under the complete control of the American Smelting and Refining Company, although during the early fall, and particularly in November, also, premiums on outside lead were paid. The changes in the prices made by the company were as follows: The metal entered the year at 4.25 cents, New York, for common lead, the price fixed in December. On January 14 the price was raised to 4.40 cents, and on the 20th to 4.50 cents. On the 29th the price was lowered to 4.40 cents and remained there until March 1, when it was again advanced to 4.50 cents. On May 20 it dropped to 4.35 cents, declined to 4.25 cents on the 27th, to 4.20 cents on June 14, and to 4.10 cents on July 25. On August 29 the price was put up to 4.20 cents, and was maintained at that figure during the fall and winter in spite of the fact that increasing premiums were paid to outside producers. On December 1 the price was suddenly advanced to 4.60 cents.

ZINC.

By Charles Kirchhoff.

PRODUCTION.

The year 1904 was one of extraordinary expansion in the production of spelter, the increase over 1903 having been 27,483 short tons, or close to 17 per cent. In 1891 the record increase of 27 per cent over the preceding year was reached.

The growth of the industry in the United States is shown by the following statistics of production of spelter:

Production of spelter in the United States, 1873–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
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	1904	186,702

In the different States the production has been as follows:

Production of spelter in the United States, by States, 1882–1904.

[Short tons.]

Year.	Eastern and Southern States.	Illinois.	Kansas.	Missouri.	Colorado.	Total.
1882	5,698	18,201	7,366	2,500	....	33,765
1883	5,340	16,792	9,010	5,730	....	36,872
1884	7,861	17,594	7,859	5,230	....	38,544
1885	8,082	19,427	8,502	4,677	....	40,688
1886	6,762	21,077	8,932	5,870	....	42,641
1887	7,446	22,279	11,955	8,660	....	50,340
1888	9,561	22,445	10,432	13,465	....	55,903
1889	10,265	23,860	13,658	11,077	....	58,860
1890	9,114	26,243	15,199	13,127	....	63,683
1891	[a] 8,945 [b] 4,217	28,711	22,747	16,253	....	80,873
1892	[a] 9,582 [b] 4,913	[c] 31,383	24,715	16,667	....	87,260
1893	[a] 8,802 [b] 3,882	[c] 29,596	22,815	13,737	....	78,832
1894	[a] 7,400 [b] 1,376	[c] 28,972	25,588	11,992	....	75,328
1895	[a] 9,484 [b] 3,697	[c] 35,732	25,775	14,998	....	89,686
1896	[a] 8,139 [b] 2,427	[c] 36,173	20,759	14,001	....	81,499
1897	[a] 7,218 [b] 3,365	[c] 37,876	33,396	18,125	....	99,980
1898	8,631	[c] 47,103	40,132	19,533	....	115,399
1899	8,805	[c] 50,118	52,021	18,107	....	129,051
1900	8,259	[c] 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
1904	14,893	[g] 47,740	107,048	12,150	4,871	[h] 186,702

[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.
[g] Including West Virginia.
[h] Including 3,300 short tons dross spelter.

CONDITION OF THE INDUSTRY.

The principal increase in the production of the metal has taken place in Kansas, where new plants were started by the Caney Zinc Company, at Caney; by the Chanute Zinc Company, at Chanute, and by the Cockerill Zinc Company, at Altoona. The La Harpe Smelting Company, at Laharpe, which started in 1903, had a full year's production. The Granby Mining and Smelting Company was enlarged by one block, making four. Both the Caney and the Cockerill companies are adding two blocks to their three block plants. The large works of the Edgar Zinc Company, at Cherryvale, controlled by the United States Steel Corporation, reached its full product in 1904.

In Illinois the Illinois Zinc Company built an addition of 120 retorts; and the Mineral Point Zinc Company, controlled by the New Jersey Zinc Company, is building large new works at Depue. During 1904 there were started the new works of the Graselli Chemical Company, of Cleveland, whose product is included in the eastern and southern group, the works being located at Clarksville, W. Va. The United States Zinc Company, at Pueblo, Colo., which is owned by the American Smelting and Refining Company, has put up two additional furnaces, thus increasing the capacity by 25 per cent.

The production of Missouri was restored to its former place by the resumption of operations of the Nevada plant by A. B. Cockerill. The Sandoval works have made a larger product, while the Indiana plants were idle altogether.

Zinc oxide.—The production of zinc oxide is estimated at 119,226,262 pounds, as compared with 119,124,160 pounds in 1903. This is exclusive of the lead zinc pigment made directly from ore by the United States Smelting Company, of Canyon City, Colo.

THE ZINC MINES.

During 1904 the Missouri-Kansas district shipped a record quantity of zinc ore, the following statement of ore sales for 1902, 1903, and 1904, compiled by local authorities, showing the participation by the different camps:

Sales of zinc and lead ore in the Missouri-Kansas district in 1902, 1903, and 1904.

[Short tons.]

Camp.	Zinc ore.				Lead ore.			
	Quantity.			Value.	Quantity.			Value.
	1902.	1903.	1904.		1902.	1903.	1904.	
Webb City-Carterville	44,693	44,917	93,377	$3,510,969	9,118	9,880	16,508	$915,879
Joplin	73,690	63,870	72,428	2,796,923	10,206	8,084	8,732	483,829
Galena Empire	30,339	23,402	22,852	800,155	3,096	2,892	3,546	197,860
Alba and Neck City	7,043	9,454	16,997	655,795	233	153	157	8,755
Aurora	19,395	13,785	15,611	482,605	261	238	263	15,195
Granby	8,459	8,067	12,335	311,555	1,089	809	1,249	69,815
Carthage	5,958	6,453	8,218	318,070	28	199	124	6,760
Badger			6,394	276,165			88	5,010
Zincite	7,503	6,408	3,985	150,700	205	128	133	7,060
Mitchell			2,993	120,010			301	16,430
Duenweg	13,679	17,600	1,442	53,088	1,640	3,010	1,480	77,128
Spurgeon-Spring City	4,383	2,751	1,980	53,982	1,159	916	550	27,865
Carl Junction	7,051	5,592	1,725	63,405		11	81	4,265
Beef Branch			1,185	25,765			818	34,580
Central City	3,630	2,813	1,171	34,370	234	263	157	8,790
Cave Springs	4,594	2,410	902	30,195	242	295	129	6,830
Reeds			1,015	36,045			6	340
Diamond			951	35,250			12	700
Baxter Springs			633	21,245			150	8,550

Sales of zinc and lead ore in the Missouri-Kansas district in 1902, 1903, and 1904—Cont'd.

[Short tons.]

Camp.	Zinc ore.				Lead ore.			
	Quantity.			Value.	Quantity.			Value.
	1902.	1903.	1904.		1902.	1903.	1904.	
Stotts City	1,431	338	210	$8,445			16	$910
Prosperity	10,929	5,720			1,182	735		
Oronogo	9,225	7,507			477	221		
Miscellaneous	4,336	6,602	389	12,940	972	696	30	1,645
Total, 1904			266,793	9,797,677			34,530	1,898,196
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

The production of ore was stimulated in the Missouri-Kansas district by the development of a sharper demand during the second half of the year accompanied by rising prices. It was only for a brief period in July that the mines temporarily restricted production by agreement.

The year 1904 witnessed increasing activity in utilizing the zinciferous ores of a number of districts in the Rocky Mountain regions, which have already become important sources of supply and which promise, from preparations under way, to reach considerably greater dimensions. Colorado is even now shipping a large quantity of concentrates, the Leadville district yielding the greater part of the crude ore. There are in operation at Leadville two concentrating plants operated by the Western Mining Company, one utilizing the Wetherill process, owned by the Resurrection Gold Mining Company, and one which was approaching completion, owned by the Yak Mining, Milling, and Tunnel Company.

In Utah a large concentrating mill is being erected to treat ores and the dump of the Horn silver mine, and the Wood River Zinc Company is building a plant near Hailey, Idaho. At Butte the Montana Zinc Company will treat the ores of the Alice mine, while the Butte Copper and Zinc Company is to utilize the zinc ores of the Emma mine in the same district. Shipments of zinc ore are also being made by the Graphic and Kelly mine at Magdalena, N. Mex. Some zinc ore is being imported from the Slocan district in British Columbia, and the possibilities of securing supplies from northern Mexico are being studied.

There has been greater activity in zinc mining, too, in Wisconsin, Kentucky, Virginia, and Tennessee.

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, 1867–1904.

[Pounds.]

Year ending—	Block or pigs.		Sheets.		Old.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.		
June 30—								
1867	5,752,611	$256,366	5,142,417	$311,767	....	....	$1,835	$569,968
1868	9,327,968	417,273	3,557,448	203,883	....	....	1,623	622,779
1869	13,211,575	590,332	8,306,723	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	3,593,570	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	947,322	56,082	4,611,360	298,308	....	....	18,427	372,817
1877	1,266,894	63,250	1,341,333	81,815	....	....	2,496	147,561
1878	1,270,184	57,753	1,255,620	69,381	....	....	4,892	132,026
1879	1,419,791	53,294	1,111,225	53,050	....	....	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	207,032	....	....	4,940	948,936
1883	17,067,211	655,503	3,309,239	141,823	....	....	5,606	802,932
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	136,138	1,092,400	40,320	....	....	9,162	185,620
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	115,203	$6,556	20,677	45,969
1893	425,183	22,790	28,913	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	24,257	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	85,882
1903	403,355	19,161	258,770	8,537	325,331	11,772	10,376	49,846
1904	682,523	34,211	34,385	2,230	72,434	3,247	10,394	50,082

Imports of zinc oxide, 1885–1904.

[Pounds.]

Year ending—	Dry.	In oil.	Year ending—	Dry.	In oil.
June 30, 1885	2,233,128	98,566	December 31—		
December 31—			1895	4,546,049	129,343
1886	3,526,289	79,788	1896	4,572,781	311,023
1887	4,961,080	123,216	1897	5,564,763	502,357
1888	1,401,342	51,985	1898	3,342,235	27,050
1889	2,686,861	66,240	1899	3,012,709	41,699
1890	2,631,458	102,298	1900	2,618,808	38,706
1891	2,839,351	128,140	1901	3,199,778	128,198
1892	2,442,014	111,190	1902	3,271,385	163,081
1893	3,900,749	254,807	1903	3,487,042	166,034
1894	3,371,292	59,291	1904	2,585,661	224,244

Exports of zinc and zinc ore of domestic production, 1864–1904.

Year ending—	Ore or oxide.		Plates, sheets, pigs, or bars.		Value of manufactures.	Total value.
	Quantity.	Value.	Quantity.	Value.		
June 30—	*Cwt.*		*Pounds.*			
1864	14,810	$116,431	95,738	$12,269	....	$128,700
1865	99,371	114,149	184,183	22,740	....	136,889
1866	4,485	25,091	140,798	13,290	....	38,381
1867	3,676	32,041	312,227	30,587	....	62,628
1868	8,344	74,706	1,022,699	68,214	....	142,920
1869	....	65,411	....	....	....	65,411
1870	15,286	81,487	110,157	10,672	....	92,159
1871	9,621	48,292	76,380	7,823	....	56,115
1872	3,686	20,880	62,919	5,726	....	26,606
1873	234	2,304	73,953	4,656	....	6,960
1874	2,550	20,037	43,566	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	4,333	82,243
1877	6,428	34,468	1,419,922	115,122	1,118	150,708
1878	16,050	83,831	2,545,320	216,580	567	300,978
1879	10,660	40,399	2,132,949	170,654	....	211,053
1880	13,024	42,036	1,368,302	119,264	....	161,300
1881	11,390	16,405	1,491,786	132,805	168	149,378
1882	10,904	13,736	1,489,552	124,638	....	138,374
1883	3,045	11,509	852,333	70,981	734	83,224
1884	4,780	16,685	126,043	9,576	4,666	30,927
1885	6,840	22,824	101,685	7,270	4,991	35,085
December 31—						
1886	26,620	49,455	917,229	75,192	13,526	138,173
1887	4,700	17,286	136,670	9,017	16,789	43,092
1888	4,560	18,034	62,234	4,270	19,098	41,402
1889	26,760	73,802	879,785	44,049	35,732	153,583
1890	77,360	195,113	3,295,584	126,291	23,587	344,991
1891	115,820	149,435	4,294,656	278,182	38,921	466,538
1892	18,380	41,186	12,494,335	669,549	166,794	877,529
1893	980	1,271	7,446,934	413,673	224,787	639,731
1894	....	5	3,607,050	144,074	99,406	243,485
1895	480	1,008	3,060,805	153,175	50,051	204,234
1896	41,500	47,408	20,260,169	1,013,620	51,001	1,112,029
1897	165,200	211,350	28,490,662	1,356,538	71,021	1,638,909
1898	210,400	299,870	20,998,413	1,033,959	138,165	1,471,994
1899	503,940	725,944	13,509,316	742,521	143,232	1,611,697
1900	751,100	1,133,663	44,802,577	2,217,693	99,288	3,450,644
1901	788,500	1,167,684	6,780,221	288,906	82,046	1,538,636
1902	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
1904	641,260	905,782	20,293,869	1,094,490	117,957	2,118,229

During 1904 a fair quantity of New Jersey ore was exported via New York, and Colorado shipped a larger quantity via Galveston.

Exports of zinc ore, by customs districts, during 1901, 1902, 1903, and 1904.

[Long tons.]

Customs district.	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
New York	24,092	$694,995	20,883	$582,229	23,722	$649,970	22,188	$615,722
Philadelphia	2,039	62,145						
Galveston	291	8,512	27,817	834,520	11,227	331,350	9,198	275,530
New Orleans	13,003	402,032	290	8,600				
Newport News			587	17,610				
All other districts			185	6,145	239	5,680	677	14,530
Total	39,425	1,167,684	49,762	1,449,104	35,188	987,000	32,063	905,782

The following table shows the destination of the ore exports:

Exports of zinc ore, by countries, during 1901, 1902, 1903, and 1904.

[Long tons.]

Country.	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Austria-Hungary			90	$2,700	80	$2,400		
Belgium	13,167	$406,734	30,138	895,824	11,813	346,350	8,264	$245,030
Netherlands	26,137	757,295	19,244	541,980	23,163	634,200	22,272	617,600
Germany	1	40			115	3,450	1,287	38,180
United Kingdom	120	3,615	290	8,600	17	600	89	2,700
All other countries							151	2,272
Total	39,425	1,167,684	49,762	1,449,104	35,188	987,000	32,063	905,782

The exports of spelter, by customs districts and by countries of destination, are exhibited in the following table:

Exports of zinc, by customs districts, during 1901, 1902, 1903, and 1904.

[Pounds.]

Customs district.	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
New York	3,827,740	$159,832	1,455,101	$63,731	598,336	$36,384	753,340	$52,025
Philadelphia					689	49		
Norfolk and Newport News	710,200	30,631	4,277,241	198,156	1,704,491	86,088	2,536,331	127,673
Baltimore			16,525	900	62,900	3,897	121,066	5,500
New Orleans	1,171,068	53,074	1,344	78	6,557	462	7,214,519	383,306
Detroit			3,838	229	179,840	10,607	1,204,528	59,864
Huron	936,227	38,507	196,549	9,331	183,188	10,592	793,676	41,459
All other districts	134,986	6,862	522,537	28,132	305,910	15,300	[a]7,522,482	424,663
Total	6,780,221	288,906	6,473,135	300,557	3,041,911	163,379	20,145,942	1,094,490

[a] Galveston reports 7,307,402 pounds, valued at $412,318.

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, 1903, and 1904.

[Pounds.]

Country.	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Belgium	83,545	$3,770					56,620	$3,114
Germany	1,000	50	162,351	$7,394			2,100	140
Netherlands			68,851	3,197			65,400	2,700
United Kingdom	5,167,274	218,841	5,256,329	237,345	1,767,391	$89,985	17,839,853	974,636
Canada	1,035,020	43,753	234,390	12,256	401,584	23,305	1,982,216	101,625
All other countries	493,382	22,492	751,214	40,365	872,936	50,089	199,753	12,275
Total	6,780,221	288,906	6,473,135	300,557	3,041,911	163,379	20,145,942	1,094,490

CONSUMPTION.

The consumption of spelter was on an unprecedented scale during 1904, the requirements being very heavy, particularly during the second half of the year. Reports of stocks by the producers are not complete, so that close figures relative to the consumption can not be presented. A partial report shows a reduction from 10,538 short tons on January 1, 1904, to 6,521 short tons on January 1, 1905. On the basis of these figures, and of the known statistics of production and of imports and exports, the apparent home consumption for a series of years was as follows:

Estimated consumption of spelter, 1897–1904.

[Short tons.]

	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Production	99,980	115,399	129,051	123,886	140,822	156,927	159,219	186,702
Imports	1,279	1,303	1,392	961	357	448	202	341
Add decrease of stock during year	1,768	2,014	897		3,908			4,017
Total supply	103,027	118,716	131,340	124,847	145,087	157,375	159,421	191,060
Deduct—								
Exports of foreign		18		23				2
Exports of domestic	14,245	10,499	6,755	22,410	3,390	3,237	1,521	10,147
Increase of stock during year				3,015		1,456	3,519	
Total	14,245	10,517	6,755	25,448	3,390	4,693	5,040	10,149
Apparent home consumption	88,782	108,199	124,585	99,399	141,697	152,682	154,381	180,911

PRICES.

The year 1904 opened with a quiet spelter market, but with a hardening tendency which developed in February and March and culminated in April in an advance to 5.25 cents, New York, for common western spelter. Then prices began to sag as the result of a declining demand, notably on the part of galvanizers. Stocks accumulated until relief was afforded by the sale to Europe of about 6,000 tons in August. Very soon afterwards the general industrial revival, which was more particularly marked in the iron and copper trades, carried spelter with it, a sharp advance taking place in November and December. Toward the close of the year the price crossed 6 cents per pound at New York.

The following table summarizes the prices of spelter since 1875:

Prices of common Western spelter in New York City, 1875–1895.

[Cents per pound.]

Year.	Highest.	Lowest.	Year.	Highest.	Lowest.
1875	7.35	6.20	1886	4.60	4.25
1876	8	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	4.65
1881	6	4.75	1892	4.90	4.35
1882	6	4.50	1893	4.50	3.55
1883	4.75	4.30	1894	4	3.25
1884	4.65	4	1895	4.35	3.10
1885	4.62	4			

Price of common Western spelter in New York City, 1896–1904, by months.

[Cents per pound.]

Year.	January.		February.		March.		April.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1896	4.05	4	4.15	4	4.15	4.10	4.20	4.05
1897	4.10	3.90	4.10	4	4.15	4.10	4.15	4.10
1898	4	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	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
1904	5.10	4.90	5.10	4.95	5.20	5.05	5.27	5.20

Price of common Western spelter in New York City, 1896–1904, by months—Continued.

[Cents per pound.]

Year.	May.		June.		July.		August.	
	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.	Highest.	Lowest.
1896	4.15	4	4.15	4	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	6.75	6.75	6.15	6.25	6	6	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	3.95	3.92	3.90	4	3.92
1902	4.65	4.40	4.85	4.80	5.35	5.05	5.50	5.35
1903	5.80	5.75	6.25	5.75	6.25	5.87	6	5.80
1904	5.22	4.95	4.95	4.75	4.90	4.87	5.07	4.90

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	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	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	4.50
1903	6.10	6	6.12	6	6	5.25	5.25	4.65
1904	5.15	5.07	5.37	5.15	5.80	5.37	6.12	5.80

THE WORLD'S PRODUCTION.

Messrs. Henry 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, 1896–1904.

[Long tons.]

Country.	1904.	1903.	1902.	1901.	1900.	1899.	1898.	1897.	1896.
Belgium	137,780	129,000	122,030	123,360	117,355	121,015	117,875	114,425	111,325
Rhine district	64,360	61,315	55,690	55,910	51,435	50,735	53,090	52,740	52,735
Holland	12,895	11,515	9,910	7,855	6,845	6,235	6,700	6,600	4,770
Great Britain	45,490	43,415	39,610	30,055	29,830	31,715	27,940	23,550	24,880
France and Spain	48,310	41,780	39,540	39,425	41,455	44,925	43,280	42,810	39,350
Silesia	123,695	116,835	115,280	106,385	100,705	98,590	97,670	94,045	95,875
Austria and Italy	9,100	9,025	8,460	7,700	6,975	7,190	7,115	8,185	9,255
Poland	10,440	9,745	8,150	5,935	5,875	6,225	5,575	5,760	6,165
Total Europe	452,070	422,630	398,670	376,625	360,475	366,630	359,245	348,115	344,355
United States	166,700	142,159	140,114	125,734	110,612	115,224	103,061	89,268	72,767
Total world's production	618,770	564,789	538,784	502,359	471,087	481,854	462,306	437,383	417,122
United States' percentage of world's production	26.9	25.2	26.0	25.1	23.5	23.9	22.3	20.4	17.4

The Vieille Montagne Company is by far the leader among the spelter producers of the world, having made at its own works and at those controlled by it 87,475 long tons of spelter. Next in importance are the New Jersey Zinc Company group, the Schlesische and the Hohenlohe works with over 29,000 tons each, followed by the Edgar and the Giesche works with over 26,000 tons each, by the Lanyon Zinc Company with nearly that quantity, and by the Asturienne and the Stolberg companies with over 22,000 tons each.

The statistics of the zinc industry of Upper Silesia show that there were 20 smelting works, with 478 furnaces and 27,560 muffles, which employed 6,568 men and 1,187 women. The average wages of the former were 995.91 marks and of the latter 337.90 marks per annum. The works consumed 225,768 metric tons of calamine, 370,208 tons of blende, and 5,593 tons of furnace by-products. Of the ore smelted, 571,446 tons was local ore, 2,381 tons was imported from Galicia, 3,119 tons from Carinthia and Styria, and 69 tons from Hungary. The product was 126,493 metric tons of spelter, whose average value was 428.23 marks; 3,585 tons of zinc dust; 24,745 tons of cadmium; and 1,403 tons of lead. The production of acid was 8,037 metric tons of 50 degrees, 51,444 tons of acid up to 60 degrees, 50,869 tons of 66 degrees, 134 tons of fuming sulphuric acid, and 1,059 tons of liquid sulphurous acid, the total valued at 1,757,667 marks. Eight sheet rolling mills employed 980 men, to whom wages aggregating 883,659 marks were paid. The mills consumed 50,627 metric tons of spelter, and produced 49,476 tons of sheet zinc and 443 tons of lead. The sheet zinc averaged 446.92 marks per ton. One plant produced 1,625 tons of zinc oxide.

ALUMINUM AND BAUXITE.[a]

ALUMINUM.

PRODUCTION.

The production of aluminum in the United States has increased nearly tenfold in as many years. Two reasons will explain this phenomenal growth—economic production, which has initiated lower prices, and increased consumption, especially in the electrical industry.

During the year the Pittsburg Reduction Company, the only producer in this country, improved its plants at New Kensington, Pa.; Niagara Falls, N. Y.; East St. Louis, Ill.; Bauxite, Ark., and Shawenegan Falls, Quebec.

The prosperity in the aluminum industry has been shared also by the Royal Aluminium Company, Shawenegan Falls, Quebec, Canada; the British Aluminium Company, with works at Foyers, Scotland; the Société Électro-Métallurgique Française, of Le Praz, Savoy, France; the Compagnie des Produits Chimiques d'Alais, of St. Michel, Savoy, France; and the Aluminium-Industrie-Aktien-Gesellschaft, of Neuhausen, Switzerland; Rheinfelden, Baden, Germany; and Lend Gastein, near Salzburg, Austria.

The processes employed are the Hall in the United States and Canada, the Hall and Minet and the Heroult in France, and the Heroult in Switzerland, Germany, and Austria.

The magnitude of the aluminum industry is shown by the following statistical data, the first table giving the production of aluminum in the United States since the beginning of the industry in 1883:

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[a] Credit for the report on aluminum and bauxite should be given to Dr. Charles C. Schnatterbeck.—D. T. D.

Production of aluminum in the United States, 1883–1904.

[Pounds.]

Year.	Quantity.	Year.	Quantity.
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	1904	a 8,600,000
1893	333,629	Total	57,062,779
1894	550,000		

a Consumption.

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 1903.

Aluminum imported and entered for consumption in the United States, 1870–1890.

[Pounds.]

Year ending—	Quantity.	Value.	Year ending—	Quantity.	Value.
June 30—			June 30—		
1870		$98	1881	517	$6,071
1871		341	1882	566	8,540
1872			1883	426	5,910
1873	2	[illegible]	1884	590	8,416
1874	683	[illegible]	1885	439	[illegible]
1875	131	[illegible]	December 31—		
1876	139	1,412	1886	452	[illegible]
1877	111	[illegible]	1887	1,260	[illegible]
1878	251	[illegible]	1888	1,348	[illegible]
1879	284	[illegible]	1889	1,006	[illegible]
1880	341	[illegible]	1890	[illegible]	[illegible]

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	5,992	$6,266	10,668	$1,136			$1,161	$8,562
1892	83	61	11,640	1,204			1,036	2,299
1893	7,810	4,683	12,700	1,363			1,679	8,925
1894	6,300	2,644	16,799	1,210			396	4,150
1895	26,261	7,811	6,610	636			1,841	10,291
1896	856	321	4,657	525			2,366	3,179
1897	1,822	1,002	1,260	95	1,421	$1,168	221	4,729
1898	50	30	2,000	174	12,112	9,991	4,676	15,870
1899	53,622	9,126	693	112	1,261	2,118	6,208	17,563
1900	256,120	11,156	1,163	107	1,261	2,776	8,111	20,111
1901	664,394	101,168			7,761	6,419	261	108,738
1902	746,257	216,082	310	32	1,022	2,538	1,229	218,881
1903	456,065	135,298			1,276	2,038	1,336	143,171

WORLD'S PRODUCTION.

The following table gives the world's production of aluminum in 1901, 1902, and 1903:

World's production of aluminum in 1901, 1902, and 1903.

[Metric tons.]

Country.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	3,241	$2,238,000	3,311	$2,284,900	3,402	$2,325,000
Switzerland	2,500	1,225,000	2,500	1,291,125	2,500	1,313,125
France	1,200	600,000	1,356	638,850	1,700	849,026
United Kingdom	560	267,680	600	303,000	650	328,250
Total	7,501	4,330,680	7,766	4,521,115	8,252	4,833,400

A departure of some interest is the attempt to utilize the extensive deposits of bauxite at Lecce, Italy, and the water falls of Pescara to generate electric power for the purpose of manufacturing aluminum. It is understood that Italian and German capital has become interested in this new enterprise.

INVENTIONS.

Inventions have been many in 1904, not alone in the United States but also in Great Britain, Germany, and France. Among the more important is an electrolytic process for manufacturing aluminum, described in United States patent No. 763479, issued to Gustave Gin. This method consists in decomposing by an electric current an electrolyte of fluoride of aluminum and sulphide of sodium. Walter Rübel has also perfected a process (U. S. patent No. 770389) of producing aluminum by mixing clay with phosphate of calcium, sulphuric acid, and a carbonaceous substance, subsequently heating the mass.

PRICES OF ALUMINUM AND ITS CHIEF ALLOYS.

For several years there has been no change in prices of aluminum, although current quotations are considerably lower than they were a decade ago, when it was acknowledged by manufacturers throughout the world that prices must recede if aluminum was to replace copper as an electrical conductor. Some of the earlier sales were made to electrical engineering firms at as low as 28 to 29 cents per pound delivered, and since then the continued high price asked for copper has given further advantage to sellers of aluminum. In 1895 the prices for aluminum were 48 cents to 63 cents per pound for No. 1, 98 per cent pure, and 45 to 55 cents per pound for No. 2, 94 per cent pure. Ten years later, in 1904, the schedule of prices was as follows:

Prices per pound of aluminum and its alloys in 1901, 1902, 1903, and 1904.

	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 value of aluminum bronze ingots varies from 19 cents per pound for 2½ per cent to 21½ cents per pound for 10 per cent alloy. A graduated price list is issued for seamless aluminum tubing, and for rod, wire, and sheet metal, the variations depending principally on size.

TECHNOLOGY.

Uses.—Aside from the electrical industry in which aluminum is gaining favor as a substitute for copper conductors for the transmission of light and power, there has been expansion in other directions. The steel industry has become an important consumer of aluminum. Usually from 2 to 5 ounces of aluminum are employed per ton of open-hearth steel made, and from 6 to 8 ounces for Bessemer steel. The object in adding aluminum in the casting ladle is to reduce the slag or oxide formed while pouring the steel. If every ton of steel manufactured in the United States in 1904 had been subjected to this treatment there would have been something like 5,000,000 pounds of aluminum consumed. Among the other uses of aluminum may be mentioned spools and bobbins for textile mill work, household and military utensils, parts of vibrating and reciprocating machines, equipments for railway cars, oil cups on locomotive driving shafts, pigment and foil to replace silver and tin, letter boxes, lithographic plates, alloys, in pyrotechny as a substitute for magnesium, in patented explosives like ammonal, in pattern making to replace wood, acid carboys and other chemical vessels, cash checks, bicycle and motor car fittings, chains for hoisting, and jewelry.

Electrical conductors.—This is one of the most promising fields for aluminum. As compared with copper, the cost of transportation and erection of aluminum conductors is less, the durability greater, and the cost of maintenance lower. Contrary factors on the part of aluminum conductors are difficulty in making joints, sag due to large coefficient of expansion, and insufficient strength of the wires in sizes ordinarily employed for telegraph and telephone lines. A small percentage of copper added to aluminum would increase the strength of the wires, but somewhat impairs their conductivity. However, there have been some large installations of aluminum conductors for transmitting light and power to important manufacturing and railway plants.

Soldering aluminum.—This is one of the perplexing problems which have a deterring influence on the development of the aluminum manufacturing industry. Mechanical joints give some satisfaction, but there are numerous instances where soldering would be preferable, and it is not surprising that inventors have visions of vast wealth should they succeed in patenting an ideal solder for aluminum. In United States patent, No. 778025, Ricardo Fortun and Eduardo Semprum describe a solder consisting of silver, aluminum, and tin partially phosphorized and zinc partially sulphurated. L. Trezel (British patent, No. 4673, of 1904) suggests a solder made of bismuth, zinc, and nickel combined. A flux consisting of chloride of silver or mercury, forming an alloy on the surface of aluminum, will facilitate soldering, according to C. Ellis and O. J. Flanigan (British patent, No. 26292, of 1903).

Electroplating.—Investigations in electroplating aluminum are many, but comparatively few have resulted satisfactorily. An interesting patent (Great Britain, No. 21609, of 1903) has been taken out by G. Creswick and H. Shaw for preparing aluminum articles for gold and silver plating by first depositing on the aluminum a film of tin by immersion in a bath of chloride of tin and ammonium alum.

Thermit.—The consumption of thermit shows marked expansion. Russia has purchased heavily to repair its damaged war ships. Thermit consists of four parts of powdered aluminum and one part of powdered oxide of iron, mixed mechanically. The inventor, Doctor Goldschmidt, buys the aluminum in lump form and the sesquioxide of iron in the shape in which it comes from rolling mills as a by-product. Thermit is made in Germany and is imported into the United States, paying a duty of 45 per cent ad valorem. For welding iron and steel and for reducing refractory oxides thermit has no equal. By its use carbonless metals can be manufactured at considerably less cost than heretofore. Chromium metal, 98 to 99 per cent pure, free from carbon, can be bought in New York at 80 cents per pound; manganese, 98 to 99 per cent, technically free from iron, at 75 cents per pound, and molybdenum, 98 to 99 per cent, at $2.75 per pound.

A valuable by-product in the thermit process is the aluminogenetic slag. This is produced largely in the purification of chromium. The slag, or artificial corundum, called "corubin," is nearly free from such impurities as oxide of iron and silica, and is absolutely free from water. This no doubt explains its greater hardness as compared with natural corundum. Corubin is used for emery wheels and for chemical vessels, because it can be made plastic by the addition of clay, as a refractory coating for bricks which are subjected to high temperatures, and for making crucibles for the thermit welding process.

Alloys.—This is a fertile field for invention, to judge by the many patents issued for aluminum alloys having unusual hardness, strength, and resistance to distortion from impact, pressure, or extension, and with the further advantage of melting readily at a low temperature and of flowing freely and shrinking little on cooling. These alloys contain varying percentages of aluminum in combination with copper, nickel, silver, zinc, magnesium, manganese, tin, chromium, tungsten, titanium, and vanadium. Some of the better known alloys are partinium, magnalium, zincalium, albradium, alumard, macadamite, ferro-aluminum, wolframium, romanium, aluminum-nickel, aluminum-zinc, and aluminum-silver. An improved alloy for light articles has been patented (Great Britain, No. 22073, of 1903) by F. W. Green and T. Prescott, which consists of 70 to 90 parts aluminum, 5 to 18 parts magnesium, and 2 to 12 parts cadmium. A process to harden aluminum by melting with a small proportion of potassium chloride has been patented (Great Britain, No. 20758, of 1903) by C. Sorensen.

Some interesting experiments with alloys have recently been made at the German Imperial Laboratory. One specimen contained 15 per cent aluminum, 61.5 per cent copper, 23.5 per cent manganese, and 0.1 per cent lead. A second specimen showed the presence of 10.7 per cent aluminum, 67.7 per cent copper, 20.5 per cent manganese, and 1.2 per cent lead. Rods were turned from these alloys 18 centimeters long and 0.6 centimeters in diameter. The first-named alloy could be easily worked, but the second proved to be somewhat brittle. The rods were submitted to a magnetizing force and an induction test. The alloys were found to be somewhat magnetic, and at varying temperatures showed remarkable properties.

BAUXITE.

PRODUCTION.

The output of bauxite in the United States in 1904 amounted to 47,661 long tons, valued at $235,704, as compared with 48,087 tons, valued at $171,306, in 1903, a decrease in quantity of 426 tons and an increase in value of $64,398. More than one-half the production in 1904, was reported by Arkansas, the remainder being from Georgia and Alabama. Deposits of bauxite also occur in several other States, especially North Carolina and South Carolina, but the mineral is not pure enough to encourage extensive development.

The following table gives the production and value of bauxite for each year since 1889:

Production of bauxite in the United States, 1889–1904, by States.

[Long tons.]

<table>
<tr><th>Year.</th><th>Georgia.</th><th>Alabama.</th><th>Arkansas.</th><th>Total.</th><th>Value.</th></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>
<tr><td>1904</td><td colspan="2">21,913</td><td>25,748</td><td>47,661</td><td>235,704</td></tr>
</table>

The figures showing the output and value of the production of bauxite during 1904 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.

In the past two years the United States has made a large production, but the supply is insufficient to satisfy the demand. Consequently there were imported in 1904 a total of 15,475 long tons of bauxite, valued at $49,577, the duty being $1 per ton, which is equivalent to nearly 30 per cent of the average invoice value. The greater part of these imports is red bauxite from France, analyzing from 50 to 62 per cent alumina, from 24 to 28 per cent ferric oxide, and from 1 to 7 per cent silica. The white variety contains from 65 to 74 per cent alumina, from 0.25 to 3 per cent ferric oxide, and from 12 to 18 per cent silica. The red bauxite is used for the manufacture of aluminum, and the white for the preparation of alum and aluminum sulphate. It is also customary to utilize the intermediate varieties mixed with clay for fire brick. A typical domestic alum bauxite contains from 60 to 61 per cent alumina.

In three years there have been no exports of bauxite, high ocean freight rates, coupled with an increasing domestic consumption, explaining the situation.

CONSUMPTION.

In order to show the annual consumption of bauxite and its value in the United States during the last seven 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 United States, 1898–1904.

[Long tons.]

Year.	Production.		Imports.		Exports.		Consumption.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1898	25,149	$75,437	1,201	$4,238	1,000	$2,000	25,350	$77,675
1899	35,280	125,598	6,666	23,768	2,030	4,567	39,916	144,799
1900	23,184	89,676	8,656	32,967	1,000	3,000	30,840	119,643
1901	18,905	79,914	18,313	67,107	1,000	3,000	36,218	144,021
1902	27,322	121,465	15,790	54,410	Nil.	....	43,112	175,875
1903	48,087	171,306	14,889	49,684	Nil.	....	62,976	220,990
1904	47,661	235,704	15,374	49,257	Nil.	....	63,035	285,961

In the seven years mentioned the consumption in this country increased over 148 per cent.

PRICES.

There has been comparatively little variation in selling prices, notwithstanding the expansion in consumption. Factors that have decided this policy were large reserves of bauxite in the producing States and cheapness with which it can be mined. Besides, some of the larger consumers produce most of the bauxite they need. The value of first-grade mineral, free on board at mines, is $5.25 to $5.50 per long ton, and of second grade $4.50 to $4.75 per ton. Not infrequently producers pay a freight rate of $3.50 to $5 per ton from point of shipment to the consumers' works.

WORLD'S PRODUCTION.

There has been a healthy growth in the production of bauxite in France, primarily because of the profitable trade with the United States. The output in Ireland is necessarily limited by the high tenor of silica in the ore, which has greatly impaired its industrial value.

Deposits are known to exist also in Austria, Styria, and Italy, but only those in Italy are likely soon to be developed on a commercial scale.

The following table shows the world's production of bauxite in 1902, 1903, and 1904:

World's production of bauxite, 1902–1904.

[Metric tons.]

Country.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	29,769	$121,465	48,856	$171,306	47,661	$235,704
France	96,900	174,685	133,890	229,148	....	....
United Kingdom	9,192	13,395	6,226	7,368	....	....
Total	135,861	309,545	188,972	407,822	....	....

Since 1900 there has been a marked increase in the world's production, and the installations made at the various plants to meet the growing demand indicate that there will be further expansion in mining.

ALUMINUM SALTS.

The production of aluminum sulphate amounted to 74,481 short tons, valued at $1,417,867, in 1904, as against 80,726 short tons, valued at $1,614,520, in 1903. Of crystallized alum there was manufactured 11,563 short tons, valued at $319,189, in 1904, as against 7,574 tons, valued at $210,910, in 1903. Bauxite and Greenland cryolite were the raw materials used. The producers of alum and aluminum sulphate are the General Chemical Company, the Pennsylvania Salt Manufacturing Company, Harrison Brothers, the Cochrane Chemical Company, Charles Lennig & Company, the Erie Chemical Company, the Detroit Chemical Company, the Merrimac Chemical Company, and the Jarecki Chemical Company. Their plants are distributed through Buffalo and Brooklyn, N. Y.; Everett and Woburn, Mass.; Philadelphia and Natrona, Pa., and Camden, N. J.

Aluminum sulphate, worth 75 cents to $1.50 per pound at New York, is a good fireproofing material for wood, as it checks combustion by forming an infusible and nonconducting coating. It is also an excellent substance for preserving wood from decay. It is claimed that aluminum sulphate possesses antiseptic and preservative properties and has the additional advantage of remaining permanently in the wood. According to Joseph L. Ferrell[a] the strength of the solution is about 15° B. In treating ties and other timbers, where it is essential that they should be made proof against decay as well as fire, a certain quantity of ferric sulphate is added to the aluminum-sulphate solution. In either case the solution is applied under a pressure of

[a] Jour. West. Soc. Eng., February, 1904.

from 450 to 600 pounds per square inch. No preliminary steaming or vacuum process is employed. Wood treated in this manner, when subject to intense heat, will char at the point of contact, but will not burst into flame. The average cost of treating wood is about $9 per 1,000 feet.

Alum, employed largely in paper manufacturing, sells in New York at $1.75 per 100 pounds for lump, $1.85 for ground, $1 for porous, and $3 for powdered.

Other aluminum salts are in little demand.

Production and imports of alum and aluminum sulphate into the United States, 1898–1904.

[Short tons.]

Year.	Production.						Imports.[a]		
	Alum.			Aluminum sulphate.			Quantity.[b]	Value.	Value per ton.
	Quantity.	Value.	Per ton.	Quantity.	Value.	Per ton.			
1898	18,791	$563,730	$30.00	56,663	$1,416,675	$25.00	893	$16,187	$18.13
1899	27,276	845,556	31.00	81,805	2,106,479	25.75	858	14,953	17.49
1900	20,531	615,930	30.00	61,678	1,480,272	24.00	1,169	22,283	19.07
1901	7,775	233,250	30.00	74,721	1,793,304	24.00	1,091	20,781	19.05
1902	8,539	299,500	27.00	80,075	1,938,671	24.25	928	16,808	18.11
1903	7,574	210,910	27.85	80,726	1,614,520	20.00	776	14,483	18.66
1904	11,563	319,189	27.60	74,481	1,417,867	19.04	878	17,116	19.49

[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 tons ($119,202); in 1900, 2,207 tons ($148,832); in 1901, 1,986 tons ($146,462); in 1902, 339 tons ($21,235); in 1903, 1,386 tons ($93,465), and in 1904, 18 tons ($2,875).

QUICKSILVER.

PRODUCTION.

The production of quicksilver in the United States during 1904 amounted to 34,570 flasks (of 76½ pounds each up to June 1, 1904, and of 75 pounds each since that date), valued at $1,503,795, as compared with 35,620 flasks, valued at $1,544,934, in 1903, a decrease in quantity of 1,050 flasks and in value of $41,139.

TEXAS.

The production of quicksilver in Texas increased in quantity from 5,029 flasks in 1903 to 5,336 flasks in 1904, a gain of 307 flasks, and increased in value from $211,218 in 1903 to $232,116 in 1904, a gain of $20,898.

CALIFORNIA.

The quicksilver production in 1904 amounted to 29,217 flasks, valued at $1,270,940, as against 30,526 flasks, valued at $1,330,916, in 1903, a loss in quantity of 1,309 flasks and in value of $59,976.

Total production of quicksilver in California, 1850–1904.

[Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.]

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	[b] 30,591
1866	46,550	1885	32,073	1904	[c] 29,234
1867	47,000	1886	29,981	Total	1,972,856
1868	47,728	1887	[a] 33,825		

[a] Includes 65 flasks from Oregon.
[b] Includes 65 flasks from Nevada.
[c] Includes 17 flasks from Nevada.

The production of quicksilver in California, by counties, for 1903 and 1904, is given in the following table:

Production of quicksilver in California, by counties, during 1903 and 1904.

[Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.]

County.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
Colusa	510	$21,708	400	$17,400
Lake	2,130	85,520	3,044	132,414
Napa	7,859	359,006	5,329	231,811
San Benito	8,150	370,000	8,480	368,880
San Luis Obispo	4,592	185,430	4,896	212,976
Santa Clara	4,658	200,330	3,889	169,172
Solano	....	....	377	16,400
Sonoma	2,361	97,766	2,700	117,450
Trinity	266	11,156	102	4,437
Total	30,526	1,330,916	29,217	1,270,940

PRICES.

The average price for quicksilver per flask in San Francisco was $44.10 in 1902, $45.29 in 1903, and $43.50 in 1904.

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, 1867–1904.

[Pounds.]

Year ending—	Quantity.	Value.	Year ending—	Quantity.	Value.
June 30—			December 31—		
1867	....	$15,248	1886	629,888	$249,411
1868	152	68	1887	419,934	171,431
1869	....	11	1888	132,850	56,997
1870	239,223	107,646	1889	341,514	162,064
1871	304,965	137,332	1890	802,871	445,807
1872	370,353	189,943	1891	123,966	61,355
1873	99,898	74,146	1892	96,318	40,133
1874	51,202	52,093	1893	41,772	17,400
1875	6,870	20,957	1894	7	6
1876	78,902	50,164	1895	15,001	7,008
1877	38,250	19,558	1896	305	118
1878	294,207	135,178	1897	45,539	20,147
1879	519,125	217,707	1898	81	51
1880	116,700	48,463	1899	131	83
1881	138,517	57,733	1900	2,616	1,051
1882	597,898	233,057	1901	1,441	789
1883	1,552,738	593,367	1902	(a)	2,166
1884	136,615	44,035	1903	(a)	1,065
1885	257,659	90,416	1904	(a)	1,405

a Not stated.

EXPORTS.

The following table gives the exports of quicksilver from San Francisco during the years 1903 and 1904, amounting, respectively, to 10,722 flasks, valued at $446,845, and to 16,351 flasks, valued at $650,076:

Exports of domestic quicksilver from San Francisco in 1903 and 1904.

[Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.]

Country.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
China (Hongkong)	5,250	$213,125	9,000	$350,290
Mexico	3,326	143,474	3,433	145,004
Japan	1,370	56,475	2,582	99,553
Honduras	671	29,181	718	29,365
British Columbia	47	2,074	205	8,739
Korea	25	1,092	24	960
Costa Rica	10	449	59	2,482
Colombia	7	263		
Salvador	6	263	17	677
Russia, Asiatic	5	225		
Russian China	3	135		
Nicaragua	2	89	18	762
British Australasia			294	12,200
Philippine Islands			1	44
Total	10,722	446,845	16,351	650,076

In the following table the quantity and value of quicksilver exported from the United States from 1880 to 1904, inclusive, are given:

Exports of quicksilver from the United States, 1880–1904.

[Flasks of 76½ pounds net; 75 pounds net since June 1, 1904.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1880	37,210	$1,119,952	1893	16,631	$542,410
1881	35,107	1,025,299	1894	14,408	397,528
1882	33,875	988,454	1895	15,542	482,085
1883	30,072	808,353	1896	19,944	618,437
1884	7,370	199,685	1897	13,173	394,549
1885	6,802	209,753	1898	12,830	440,587
1886	8,091	204,956	1899	16,517	609,586
1887	11,394	441,112	1900	10,172	425,812
1888	10,684	406,899	1901	11,219	475,609
1889	5,111	213,717	1902	13,247	575,099
1890	2,069	93,192	1903	17,577	719,119
1891	3,714	145,502	1904	21,064	847,108
1892	3,518	133,626			

WORLD'S PRODUCTION AND VALUE.

With the exception of a few minor discoveries the greater part of the world's consumption of quicksilver is satisfied by the older mines. Spain, long the leading producer, is now second to the United States.

Besides the famous Almaden mines, worked by the Rothschilds under a renewal Government agreement for ten years from 1900, there are commercial deposits in the provinces of Almeria, Granada, and Oviedo. Spanish quicksilver usually sells in London at 1 shilling per flask higher than the Italian metal. This difference is partly explained by the Spanish export tax of 540 pesetas per 100 kilos, imposed in 1898 as a result of the Spanish-American war. The Italian output from mines near Monte Auriate, Tuscany, is not large, therefore any variation in price of other brands would not influence this market appreciably. The imports of quicksilver into Great Britain in 1904 amounted to 2,491,442 pounds, of which there was reexported 2,045,863 pounds. In 1903 the imports were 2,616,498 pounds and the reexports 1,413,498 pounds, indicating that the consumption in 1904 showed a falling off. The Idria mines in Austria rank third in the list of producers, and although they have been worked for four hundred and twelve years their ore reserves are estimated to last forty or fifty years longer at the present rate of mining of over 500 tons per annum.

Another country to show an increased consumption is Germany, which imported in 1904 a total of 1,522,964 pounds and reexported only 94,772 pounds. In 1903 the imports amounted to 1,485,496 pounds, of which there was reexported 136,648 pounds.

Russia has enlarged the output of its mines in the Ekaterinoslav district, which are being worked by A. Auerbach & Co. An appreciable quantity of quicksilver is exported annually to Hamburg, Germany.

In Mexico the great activity in the gold and silver mines has given an impetus to the quicksilver industry, especially in the Guadalcazar district, in San Luis Potosi, and at Huitzoco, in Guerrero. Other deposits are at Ranas, in Quertara, and at Batuc, in Sonora.

Quicksilver also occurs at Yulgibar, in New South Wales; at Huancavelica, in Peru; at Taghit, in Algeria; in Japan; in Germany; and near Akluri, in Turkey.

World's production and value of quicksilver in 1901, 1902, 1903, and 1904.[a]

[Metric tons.]

Country.	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	1,031	$1,382,305	1,190	$1,467,848	1,237	$1,544,934	1,188	$1,503,795
Austria	525	547,513	511	568,929	520	621,753	536	602,238
Italy	278	361,400	260	310,080	314	373,065	355	396,335
Russia	368	445,284	416	506,366	362	430,196	393	441,597
Spain	754	1,105,890	1,425	1,941,387	914	1,092,239	1,020	1,146,132
Total	2,956	3,842,392	3,802	4,794,610	3,347	4,062,187	3,492	4,090,097

[a] Mexico exported 335 tons of quicksilver in 1901 and 190 tons in 1904.

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STEEL AND IRON HARDENING METALS.

By Joseph Hyde Pratt.

INTRODUCTION.

There are a number of metals that are being used for steel and iron hardening purposes, and, although this is not the principal use of some of them, still, on account of the importance in the arts of this particular use, they are treated together under the one subject of steel and iron hardening metals. Under this head are included all the minerals containing these metals that are mined commercially, when the metal or the product obtained from them is used to some extent for steel-hardening purposes, whether or not this is the main use of the mineral or metal. The metals that are included under this head are nickel, chromium, manganese, tungsten, molybdenum, vanadium, titanium, cobalt, and uranium, which are named in the order of the importance of their production and use for steel-hardening purposes. As manganese is produced in such very large quantities for use in the purification of steel, its production is treated separately under the head of manganese.

In referring to these metals as steel and iron hardening metals, it is taken for granted that all the steels in which they are used for hardening purposes contain a certain amount of carbon. As far as can be learned from a study of these metals and their application in the steel industry, the presence of carbon is necessary in the steel in order for these metals to give the desired results, and Mr. R. A. Hadfield, of Sheffield, England, is authority for the statement that these metals do not really harden iron unless carbon is present.

The source of some of the above metals is one mineral alone, while others are obtained from two or more different minerals. There is given in the table which follows a list of the minerals that are mined at the present time for their metallic content of some one of the metals mentioned, and there is given in the same table the percentages of the various metals that these different minerals contain.

Minerals from which the steel-hardening metals are derived.

Metal.	Mineral.	Chemical composition.	Percentage of metal or metallic oxide in mineral.	Locality.
Nickel	Pyrrhotite[a]	$Fe_nS_n+_1$ where n varies from 5 to 16.	1 to 5 Ni	Sudbury, Canada.
	Millerite	Ni S	64.6 Ni	Gap Mine, Pa.
	Niccolite	Ni As	43.9 Ni	Ontario, Canada.
	Genthite	$Ni_2 Mg_2 Si_3 O_{10}. 6H_2 O$	22.3 Ni	Webster, Jackson County, N. C.; New Caledonia.
	Garnierite[a]	H_2 (NiMg) SiO_4?+Aq	8 to 23 Ni	New Caledonia; Douglas County, Oreg.
	Lead ore	PbS; $PbCO_3$, with Ni and Co.		Mine La Motte, Mo.
Chromium	Chromite[a]	$FeCr_2O_4$ Fe sometimes replaced partially by Mg; and the Cr by Al and ferric iron.	46.6 Cr 20 to 46.6 Cr.	Quebec Province, Canada; Newfoundland; California; North Carolina; New Caledonia; Asia Minor.
Manganese	Pyrolusite[a]	MnO_2 (commonly containing a little water).	78 to 79.5 MnO	Cartersville, Ga.; Crimora, Va.; Santiago, Cuba; Miguel Burnier, Brazil; Colon, Colombia.
	Psilomelane	Hydrous manganese manganate, H_4MnO_5(?)	65 to 75 MnO	Cartersville, Ga.; Santiago, Cuba; Brazil.
	Manganite	Mn_2O_3. H_2O	89.7 Mn_2O_3	Michigan.
	Braunite	$3Mn_2O_3$. $MnSiO_3$	11.7 MnO and 78.3 Mn_2O_3.	Batesville, Ark.; Colon; Colombia.
	Rhodochrosite.	$MnCO_3$	61.7 MnO	France.
Tungsten	Wolframite	(FeMn) WO_4	76.3 to 76.5 WO_3.	Boulder County, Colo.; Osceola, Nev.; Cochise County, Ariz.; Cornwall, England.
	Hübnerite	(MnFe) WO_4		
	Scheelite	$CaWO_4$	80.6 WO_3	Trumbull, Conn.; Kern County, Cal.
Molybdenum	Molybdenite	MoS_2	60 Mo	Cooper, Me.; Chelan County, Wash.; San Miguel County, N. Mex.
	Wulfenite	$PbMoO_4$	39.3 MoO_3	Mammoth and Troy, Ariz.
Vanadium	Vanadinite	(PbCl) Pb_4 $(VO_4)_3$	19.4 V_2O_5	Yuma and Pinal counties, Ariz.
	Volborthite and other copper vanadates.	(Cu, Ca, Ba)$_3$ (OH)$_3$ VO_4+6 H_2O, similar to above.	19.6 V_2O_5	Grand County, Utah.
	Carnotite[a]	Hydrous vanadate of uranium and potassium.	47 to 52 UO_3 and 15 to 18 V_2O_5.	Montrose County, Colo.; Grand County, Utah.
Titanium	Rutile	TiO_2	60 Ti	Roseland, Va.; Norway.
	Ilmenite	$FeTiO_3$	31.6 Ti	Kraglia, Norway; Bay St. Paul, Quebec.
Cobalt	Nickel ores	(*See* Nickel.)		
	Smaltite	CoAsS	28.2 Co	Ontario, Canada.
	Lead ore	PbS. $PbCO_3$ containing Co. and Ni.		Mine La Motte, Mo.
Uranium	Uraninite[a]	The uranate of uranyl, lead, and rare earths.	14 to 60 UO_2 and 19 to 70 UO_3.	Gilpin County, Colo.; Black Hills, S. Dak.; Mitchell County, N. C.; San Miguel County, N. Mex.
	Gummite	Altuatin product of Uraninite.	61 to 75 UO_3	Same as Uraninite.
	Carnotite[a]	(*See under* Vanadium.)		

[a] These minerals represent the chief source of the metal.

The principle sources of supply of the manganese, nickel, and chromium consumed in the United States are foreign localities, but the remaining metals are now obtained chiefly from domestic localities. New domestic deposits of minerals containing these metals are being located and developed each year; but on account of the uncertainty of the demand for a number of them and of their limited use, and because of the variation and instability of prices, there is a considerable variation in their production from year to year, with the exception of the minerals containing manganese, nickel, and chromium. Of the remaining metals, with the exception of titanium, a large proportion of the ore mined is in each case exported.

With regard to the preparation of these metals for market, it is to be noted that only within the last two years have they been prepared commercially as metals; they were formerly put on the market almost exclusively as ferro-alloys. With the introduction, however, of the alumino-thermit and other processes for reducing oxides of the metals, it became possible to obtain many of the so-called rare metals in the free state, and thus many of the steel-hardening metals are now on the market as metals as well as ferro-alloys. These processes for the preparation of the metals and ferro-alloys are described below.

Goldschmidt or alumino-thermit process.—The alumino-thermit method, as it is now designated, has been used satisfactorily in the preparation of pure refractory metals free from carbon. In this reaction the metallic oxides which are to be reduced are mixed in refractory crucibles with finely powdered aluminum and barium peroxide, or other substance that is very easily and readily ignited, this being especially true of the barium peroxide, as it contains an excess of oxygen. Some of the igniting material is also added to the top of the mixed oxides and aluminum, and then a little more of the powdered aluminum is placed on top of the igniting material. The barium peroxide is readily ignited, and the heat generated, together with the excess of oxygen, is sufficient to ignite the powdered aluminum. This at once oxidizes, and the reaction continues throughout the mixture in the crucible, the aluminum readily taking up the oxygen from the metallic oxides and reducing them to the pure metallic state. The heat generated by the reaction leaves the mass in a molten condition, the metal settling to the bottom and the aluminum, in the form of corundum, separating out on top as a slag. Thus the steel-hardening metals—manganese, chromium, tungsten, titanium, molybdenum, and vanadium—that were formerly considered almost impossible to reduce to the metallic state, can now be obtained with comparative ease. The metals resulting from this reaction are very pure, and any impurities that may have been in the original ore or oxides are for the most part taken up by the slag, which contains principally corundum, with small amounts of silicates and oxides, according to the impurities that may have been present. The corundum slag varies greatly in color, according to the metallic oxide that has been reduced. Thus, when chromite is treated the resulting slag is a corundum of a ruby-red color, often containing thin hexagonal basal crystals that are perfectly transparent. In the reduction of nickel oxide the corundum is of a grayish-blue to deep-blue color; the corundum obtained in the reduction of manganese ores is of a bright-yellow to yellowish-green color; and in reducing titanium the corundum is brownish to black. Although the reduction of these oxides appears to be a reaction of great simplicity, yet in the case of nearly every metal considerable experimental work has to be done before the pure metal of sufficiently uniform quality and with a sufficiently high efficiency can be obtained to satisfy commercial requirements. This, of course, is due partly to the condition of the material that is to be reacted upon by the alumino-thermit process and to the reduced metal itself as to its affinity for uniting with aluminum to form an alloy and its tendency to absorb certain of the other elements that would usually go into the corundum slag. In the commercial preparation of these metals and of the ferroalloys, and especially of metallic chromium and metallic manganese, a refractory crucible holding several hundred kilograms of material is used, and the material is reduced in a single operation to the metal, which usually requires about thirty minutes for its completion. As stated by Dr. Hans Goldschmidt:[a]

> The principle of the preparation of the mixture is, of course, to use equivalent quantities of the oxide and aluminum. In practice, however, the great facility with which aluminum alloys itself makes it advisable to use somewhat more of the oxide and less of the aluminum than would correspond to a mixture in equivalent proportion. The object is to oxidize all of the aluminum during the reaction and to produce the metals free from aluminum. Solely by a suitable choice of the proportions of the mixture is it possible to regulate the reaction so as to get no aluminum in the reduced metal. This will surprise the experienced metallurgist, in view of the great tendency of aluminum to alloy with the pure metals, and in view of the known fact that it is impossible to get metals free from carbon by means of reduction with carbon, even if a considerably larger amount of oxide is used than is equivalent to the carbon used for the reduction.

By the use of the process described the following metals and alloys have been obtained and are now being manufactured commercially by Th. Goldschmidt, of Essen-Ruhr, Germany, whose general agents in America are the Goldschmidt Thermit Company, of 43 Exchange place, New York. This company is not yet manufacturing any of these alloys or metals in this country.

Chromium metal, free from carbon, being 98 to 99 per cent pure and containing as impurities about 0.25 per cent Si, 0.57 per cent Fe, 0.135 per cent Al, 0.02 per cent sulphur.

Molybdenum, carbon free, containing approximately 98 per cent Mo.

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[a] Electrochemical Industry, April, 1904.

Manganese, carbon free, containing 98 to 99 per cent Mn with only 0.4 per cent Fe, about 0.3 per cent Si, and 0.3 per cent Al.

Chromium-manganese alloy, carbon free, containing 30 per cent chromium and 70 per cent manganese.

Chromium-molybdenum alloy, carbon free, containing 50 per cent of each metal.

Manganese-titanium, carbon free, containing about 30 to 35 per cent titanium.

Ferro-titanium, carbon free, containing about 20 to 25 per cent titanium.

Ferro-vanadium, carbon free, containing 25 per cent vanadium.

A further discussion of these metals and ferro-alloys is given under the separate steel-hardening metals.

This same method can undoubtedly be used in the production as pure metals of some of the other steel-hardening metals which at the present time are only produced commercially as ferro-alloys or as impure metals; and it must be remembered that, in the first preparation, the metals chromium, manganese, and molybdenum, which are now produced free from carbon and in large quantities, were first put on the market as impure metals and did not come up to the requirements of what was demanded of them. The metals obtained by this process, even when considered impure, usually contain a higher percentage of the metal desired than has been obtained by any other method.

Rossi method.—In the preparation of ferro-tungsten and other alloys by the method developed by Mr. A. J. Rossi,[a] use is also made of metallic aluminum. The method differs from the Goldschmidt or alumino-thermit process inasmuch as external heat is employed in melting the aluminum. The furnace used by Mr. Rossi in his process is of the old Siemens type in which the graphite blocks are so arranged as to leave a central cavity in which is first placed the metallic aluminum in the form of ingots, scraps, etc. The graphite forming the cathode is connected with one of the bus bars of the current, and a single or multiple carbon electrode is introduced into the cavity to form the anode, which is connected with the other bus bar by means of a flexible cable, thus permitting the electrode to be moved vertically. When the current is turned on, the aluminum is melted, and as soon as the tungsten, chromium, or molybdenum oxides are introduced with iron oxide into the molten metal the reaction begins, causing the aluminum to oxidize with incandescence and raising the furnace to a white heat. The iron is the first to be reduced to the metallic state and this forms a bath in which the tungsten, molybdenum, or chromium are dissolved. During the reaction there are dense white clouds

[a] Electrochemical Industry, vol. 1, 1903, p. 523.

has been reduced. Thus, when chromite is treated the resulting slag is a corundum of a ruby-red color, often containing thin hexagonal basal crystals that are perfectly transparent. In the reduction of nickel oxide the corundum is of a grayish-blue to deep-blue color; the corundum obtained in the reduction of manganese ores is of a bright-yellow to yellowish-green color; and in reducing titanium the corundum is brownish to black. Although the reduction of these oxides appears to be a reaction of great simplicity, yet in the case of nearly every metal considerable experimental work has to be done before the pure metal of sufficiently uniform quality and with a sufficiently high efficiency can be obtained to satisfy commercial requirements. This, of course, is due partly to the condition of the material that is to be reacted upon by the alumino-thermit process and to the reduced metal itself as to its affinity for uniting with aluminum to form an alloy and its tendency to absorb certain of the other elements that would usually go into the corundum slag. In the commercial preparation of these metals and of the ferroalloys, and especially of metallic chromium and metallic manganese, a refractory crucible holding several hundred kilograms of material is used, and the material is reduced in a single operation to the metal, which usually requires about thirty minutes for its completion. As stated by Dr. Hans Goldschmidt:[a]

> The principle of the preparation of the mixture is, of course, to use equivalent quantities of the oxide and aluminum. In practice, however, the great facility with which aluminum alloys itself makes it advisable to use somewhat more of the oxide and less of the aluminum than would correspond to a mixture in equivalent proportion. The object is to oxidize all of the aluminum during the reaction and to produce the metals free from aluminum. Solely by a suitable choice of the proportions of the mixture is it possible to regulate the reaction so as to get no aluminum in the reduced metal. This will surprise the experienced metallurgist, in view of the great tendency of aluminum to alloy with the pure metals, and in view of the known fact that it is impossible to get metals free from carbon by means of reduction with carbon, even if a considerably larger amount of oxide is used than is equivalent to the carbon used for the reduction.

By the use of the process described the following metals and alloys have been obtained and are now being manufactured commercially by Th. Goldschmidt, of Essen-Ruhr, Germany, whose general agents in America are the Goldschmidt Thermit Company, of 43 Exchange place, New York. This company is not yet manufacturing any of these alloys or metals in this country.

Chromium metal, free from carbon, being 98 to 99 per cent pure and containing as impurities about 0.25 per cent Si, 0.57 per cent Fe, 0.135 per cent Al, 0.02 per cent sulphur.

Molybdenum, carbon free, containing approximately 98 per cent Mo.

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[a] Electrochemical Industry, April, 1904.

Manganese, carbon free, containing 98 to 99 per cent Mn with only 0.4 per cent Fe, about 0.3 per cent Si, and 0.3 per cent Al.

Chromium-manganese alloy, carbon free, containing 30 per cent chromium and 70 per cent manganese.

Chromium-molybdenum alloy, carbon free, containing 50 per cent of each metal.

Manganese-titanium, carbon free, containing about 30 to 35 per cent titanium.

Ferro-titanium, carbon free, containing about 20 to 25 per cent titanium.

Ferro-vanadium, carbon free, containing 25 per cent vanadium.

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[a] Electrochemical Industry, vol. 1, 1903, p. 523.

or fumes of alumina given off, but the larger portion of the alumina formed during the reaction remains as a slag on the surface of the bath. During the reaction the current is reduced or entirely stopped until after the intensity of the reaction is over, when it is again turned on or increased for a few minutes in order to keep the product in a molten condition for some time longer, so that if there has been an excess of aluminum it can be freed by the addition of small quantities of the original oxide used. The metal is then ready for casting. Ferro-alloys containing as low as 0.2 to 0.75 per cent of carbon have been made by this process.

The most successful manufacture of the ferro-alloys, until the introduction of the alumino-thermit process, was by means of the electric furnace, and this industry is now both in Europe and America one of considerable magnitude. These ferro-alloys are obtained on a large scale for industrial purposes directly from the ores by reducing them in an electric furnace, and in some instances in a blast furnace. There was some difficulty experienced as to the purity and freedom from carbon of the first ferro-alloys prepared for the market by this method, the carbon that was found in the resultant ferro-alloy having been derived principally from the carbon of the electrodes. Since the first introduction, however, of this method of making the ferro-alloys, various devices have been invented and worked out for a better regulated temperature, for diminishing the loss of heat, and for preventing the carbon, as far as possible, from entering into the ferro-alloy. The last result has been accomplished by taking advantage of the conducting properties of the molten slag, a layer of which forms on top of the alloy, and into it the electrodes are plunged. In this way the slag forms a resistant medium between the electrodes, is heated by the passage of the current, and communicates its heat to the alloy forming materials under it. A series of interesting articles by Mr. G. P. Scholl on the manufacture of ferro-alloys in the electric furnace have recently appeared in the Electrochemical Industry.[a] The manufacture of these ferro-alloys has not received the same attention in this country as in Europe, partly on account of the higher cost of electric power, partly on account of the low duty on the ferro-alloys imported, and partly because the utilization of these ferro-alloys in the construction of various steels has not received the same attention, and their value is not, therefore, appreciated to as high a degree in the United States as in Europe. Some of the principal producers of these alloys in the United States are the Wilson Aluminum Company, Kanawha, Falls, W. Va.; the Primos Chemical Company, of Primos, Pa.; A. J. Rossi, Niagara Falls, N. Y., and the Chrome Steel Company, New York. There are furnaces of various types used in the manufacture of these ferro-alloys, the first used being the old carbide furnaces which

[a] Electrochemical Industry, vol. 2, No. 9, 1904, p. 349; No. 10, p. 395; No. 11, p. 449.

were so modified as to adapt them to this purpose. The modifications of these electric furnaces have been along the line of obtaining as pure metal as possible, especially by the elimination of carbon, of increasing the efficiency of the furnace, of minimizing the losses from the radiation of heat, of regulating and controlling the electrodes and facilitating their removal and replacement, of reducing the losses by volatilization, and of reaching temperatures which are between that of the ordinary metallurgical melting furnace and that produced by the electric arc.

The ferro-alloys made in this electric furnace for commercial purposes are ferro-silicon, ferro-manganese, ferro-chromium, ferro-tungsten, ferro-molybdenum, ferro-vanadium, and ferro-titanium. Descriptions of the production of these various ferro-alloys in the electric furnace are given under the various subheads of these alloys.

Greene and Wahl method.—The Greene and Wahl[a] method for the production of the ferro-alloys, or the reduction of the metallic oxides, which has been especially applied to the production of metallic manganese, consists essentially of the following process in its application to manganese: A ferro silicon or silico-spiegel is melted on the hearth of a furnace or in a crucible. To this molten material is then added manganese monoxide or protosesquioxide with which a fluxing material has been incorporated. A reaction takes place at once in which the silicon unites with the oxygen of the manganese ore, forming silicon dioxide which unites with the fluxing material and forms liquid slag. The manganese unites with the iron which was formerly united with the silicon. In carrying out this reaction the whole charge of manganese and flux can be added at once to the molten ferro-silicon, or it can be added a little at a time until a sufficient quantity of the oxide has been added to utilize the reducing power of all the silicon. It is necessary to add a larger quantity of manganese oxide than is theoretically required, for a certain quantity of the manganese oxide is taken up by the silica and carried into the slag in the form of a manganese silicate. This method has been applied also to the formation of ferro-nickel, ferro-chromium, and ferro-tungsten substantially in the same manner as for manganese, although it has not been done on a commercial scale. In nearly all cases the resulting ferro-alloy is low in carbon, as would be naturally expected, since the above method does not involve the introduction of any carbon from external sources beyond that which may be contained as an impurity in the materials used.

During 1904 many inquiries from abroad have been received regarding sources of supply of minerals containing these steel-hardening metals, showing that there is some demand for these minerals in Europe. Among those making inquiries are the following: Julian Pannenberg, Gardenstrasse No. 4, Anstadt i. Thür, Germany; Ellis

[a] Jour. Frank. Inst., 1893, pp. 20–26.

Wilczynski, Berg-Strasse 25, Hamburg, Germany; Bernfeld und Rosenberg, Liechtensteinstrasse 21, Vienna, Austria; Th. Goldschmidt Company, Essen-Ruhr, Germany; George G. Blackwell Sons & Co., The Albany, Liverpool, England.

The demand for these metals in the arts is constantly increasing, although the growth in the consumption of some of them is extremely slow. The production of some that are used in the manufacture of hardened steel would not increase very rapidly even with a very large increase in the production of that particular steel on account of the very small percentage of the metal that is required to give the requisite hardening properties. Where the percentage of the metal employed in giving the desired results is rather large, as in nickel and chromium steels, there is a continual growth in the consumption of the hardening metals.

Whereas formerly only the ferro-alloy of these various metals was used, now in some instances the metals themselves are used in the production of the hardened steel; but neither the ferro-alloy or the metal is ever added to the molten mass during the manufacture of the steel. They all give certain distinct characteristic properties to the steel, and in all cases they increase the hardness and the toughness of the resulting steel, and these are the principal qualities.

In the manufacture of a number of the hardened steels many of the manufacturers prefer to use the metal instead of the ferro-alloy. Thus, for example, in the production of tungsten steel used in the manufacture of tools, a number of the manufacturers prefer to use the black metallic tungsten, which is obtained by the manufacturing chemists, instead of the ferro-alloys that have been made in the electric furnace or otherwise, their claim being that this black metallic tungsten alloys more easily with the steel and is freer from carbon than the ferro-alloy. This is also true in the manufacture of molybdenum steel, the metallic molybdenum being preferred by some to the ferro-molybdenum by many of the molybdenum steel manufacturers.

NICKEL AND COBALT.

On account of the great similarity of these two metals and because nearly all the ores that contain one contain also a small percentage of the other, and as in the reduction of the ores both the nickel and the cobalt go into the matte which is afterwards refined, they are treated together. Of the two metals, however, nickel has for many years been produced largely in excess of cobalt, on account of the higher percentage of nickel in the ores mined. Recently, however, new sources of supply of cobalt ores containing but little nickel have been found in Canada, which may result in the production of cobalt in very large quantities, if a sufficient demand for cobalt can be created. As steel-hardening metals, cobalt and nickel are similar, imparting, in some instances, almost identical properties to the resultant steel. With cobalt oxide at its present high price, however, it would be impossible to produce a cobalt steel that could enter into competition with nickel steel. One advantage that the new cobalt ores of Canada may have over the general run of nickel ores is the high values in silver that the ore contains, but at the same time they contain other constituents that make them more refractory. There has been no production of cobalt steel beyond what has been obtained in experimental work, but sufficient has been done to determine the similarity of properties of cobalt steel and nickel steel.

One interesting problem that should attract the attention of those interested in the utilization of nickel steel is the production of a steel that could be used in the manufacture for household purposes of knife blades which would retain a sharp cutting edge. If a nickel steel can be made for this purpose, there should be a large demand for the material in the manufacture of silver-handled and pearl-handled knives, which would have blades that would be bright and clean in color, corresponding very well with the handles. The blades could be kept clean very easily, and there would not be a tendency to rust as in the ordinary steel knife blades. Some experiments have been made along this line, but thus far no positive results have been described. It would be well in connection with these experiments to try not only nickel but also cobalt steel with the addition of varying percentages of tungsten or molybdenum. Both tungsten and molybdenum, under certain conditions, give to steel those properties which make it especially adapted for tool steel; and by carrying out a series of experiments with tungsten, molybdenum, and vanadium, and with both nickel and cobalt, varying in the percentages of the metals, it is not improbable that a nickel or a cobalt steel could be discovered having the requisite properties for manufacture into knife blades which would retain a sharp cutting edge.

OCCURRENCES AND LOCALITIES.

Nickel and cobalt ores are known to occur in many localities through out the United States, but there has been for the last eleven years only a small production of either of these metals in this country. New discoveries are constantly made of ores of both nickel and cobalt, but on account of the difficulty of obtaining a market there has been but little incentive for developing properties where these metals have been located. During 1904 a deposit was located in the State of Washington, south of Semilkameen, on the proposed Spokane connection with the B. B. and B. C. Railway. The vein, as reported by Mr. E. P. Gilmer,[a] of Vancouver, British Columbia, was 12 feet wide, and about

[a] Northwestern Miner, Mfr. and Met., July 1, 1904.

Nickel Company, of New York, and La Société le Nickel, of Paris. There are one or two other companies working on the island, and recently the Consolidated Nickel Mines Company was operating properties which formerly belonged to the Société d'Exploitation, at Koniambo, Puya-mues. As reported, it is the intention of this company to treat the ore from their mines at the works of the Smelting Company of Australia, at Dapto, New South Wales.

NORWAY.

On the island of Ostero, on the west coast of Norway, about 18 miles north of Bergen, nickel ores consisting chiefly of pyrrhotite mixed with a little hornblende, feldspar, and quartz have been found in gabbros forming parts of several ridges which rise occasionally to a height of 1,500 feet and traverse the island from east to west. The ore bodies strike approximately east and west and dip at an angle of about 45° S. They vary in thickness from 4 to 16 feet and usually lie conformably with the stratification.

About 90 miles south of Bergen is the island of Foeoe, one of a number of islands outside of the harbor of Hangesund which are composed largely of granites, syenites, quartzites, and schists. Cutting these rocks are intrusives of gabbro or norite with which the ore bodies are associated. These strike east and west and dip south at an angle of about 45°. They are irregular in thickness, varying from 4 to 16 feet. The ore is hard and free from gangue, and a couple of cargoes of run-of-mine ore which were shipped to New York as samples assayed 2.25 per cent of nickel and 2.2 per cent of copper. This locality represents one of the most promising of any of those in Norway for the production of nickel ores.

In the southern part of Norway there are several nickel mines which have been opened, the principal ones being at Evje, Ringerike, and Askim. The Ringerike mining district is well situated, not only for mining but for transportation. The nickel mines of Askim are 33 miles by rail from Christiania and 42 miles distant from the port of Fredrikstadt, with which they are connected by railroad. The ore occurs in detached masses of pyrrhotite (with some pyrite) which vary in length from 30 to 60 feet and average in thickness about 6 feet. The handcobbed ore from this locality averages about 2.42 per cent of nickel and cobalt.

There are a number of quite extensive bodies of pyrrhotite containing nickel and cobalt, but thus far they have not been able to compete with the mines of New Caledonia and Canada. The most favorable places for mining and shipping the ore to foreign markets, or for the importation of fuel, are Ostero and Foeoe. If there were any export duty placed on the Canadian ore and matte, Norway would then be able to have a considerable share in the European nickel market, but it would probably have but little effect on the American market.

SAXONY.

There was discovered in 1900 near Carlsruhe, Sohland, Saxony,[a] a deposit of nickel ore that has attracted considerable attention. The ore occurs as part of a dike of diabase, which is 33 to 65 feet wide and has been traced along its strike for a distance of over 2,000 feet. The dike, which strikes nearly east and west, cuts through finely crystalline granites and is badly altered and decomposed near the surface, so that the dike itself is not exposed on the surface and was discovered by accident. The water obtained from a well sunk for a tannery was found so peculiar in taste and color that a sample of it was sent to Freiburg for analysis. On account of the nickel salts found in this water exploration work was undertaken which revealed the dike containing nickel ore. The ore consists of nickeliferous pyrrhotite, with a little iron pyrite and chalcopyrite. It occurs along the north wall of the dike in a seam 6 to 8 feet wide, having an irregular wavy boundary. The dike rock itself is also peculiar, in that it contains somewhat ill-defined segregations of basic masses rich in spinel, which grade into the normal rock, while other nodular segregations of sillimanite rock carry not only spinel but sapphires.

The origin of the ore is regarded by Dr. Richard Beck[a] to be as follows:

> The various sulphides of the deposit, nickeliferous pyrrhotite and pyrite, could only have been formed after complete differentiation of the magma and its solidification into proterobase, diabase, and the spinel rocks we have described. After the consolidation of the rock, *a partial corrosion of the primary silicates and the formation of secondary actinolite, as well as a chlorite, talc, and serpentine*, preceded the formation of the ore.

This ore carries from 4 to 5 per cent of nickel, a little cobalt, and 2 per cent of copper.

Nickel has been found in Queensland and Tasmania, Australia, the larger deposits being in the latter State, but little or no systematic prospecting or development work has been done on any of the deposits located in these States.

Besides the above localities, which carry principally nickel and some cobalt, there are others which contain more cobalt than nickel, and such deposits are being brought to light from time to time, although on account of the present small demand for cobalt they have not become as attractive propositions as the nickel deposits. Still, if cobalt steel can be made as cheaply as nickel steel and will give as favorable results—as experiments up to the present time seem to indicate—there should be an increase in the demand for deposits of minerals that would produce cobalt in quantity.

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[a] Zeitschr. deutsch. Geol. Gesell., 1903, and Eng. and Min. Jour., March 3, 1904.

MISSOURI.

At the present time the only cobalt ores that are mined to any extent in the United States are the lead ores at Mine Lamotte, Mo., which contain a considerable percentage of cobalt and a very small quantity of nickel. These are smelted to a slag containing lead, nickel, and cobalt, which is afterwards refined. During 1904 there were about 3,600 tons of this slag obtained. None of this matte was refined, but the company are erecting their own plant for refining this by-product that is obtained in connection with the lead mining, and during 1905 they expect to treat all the matte that they have on hand.

IDAHO.

The deposits of nickel and cobalt in Lehigh County, Idaho, from which about 60 tons of ore produced in 1903 were shipped as a sample of the ore, did not produce in 1904.

OREGON.

Near Sumpter, Oreg., in the Quartzite mining district in the Dixie Mountains, a cobalt ore has recently been discovered on the property of the Standard Consolidated Mines Company. The property was opened as a gold mine, but in assaying the ore it was found that it contained quite a large percentage of cobalt. An assay or analysis has been made of a sample of this ore by Dr. H. H. Nicholson, of the Standard company, which gave the following results:

Assay of gold-cobalt ore from Sumpter, Oreg.

Constituent.	Per cent.	Constituent.	Per cent.
Silica (SiO)	47.81	Cobalt (Co)	6.34
Sulphur (S_2)	4.43	Nickel (Ni)	.75
Arsenic (As)	20.18	Gold (Au)	.017
Iron oxide (Fe_2O_3)	17.28	Silver (Ag)	.0028
Aluminum oxide (Al_2O_3)	.12		
Calcium oxide (CaO)	2.88	Total	101.7498
Carbon dioxide (CO_2)	1.94		

The cobalt is in the form of the arsenide. If this ore should occur in quantity it may be able to furnish cobalt at a price which could readily compete with nickel, as it would have such a valuable by-product in gold; or it could be considered a gold ore with the cobalt as a valuable by-product. It might, however, prove to be a very refractory ore, thus greatly increasing the cost of production of the metal.

CANADA.

In the report for 1903 reference was made to the new discovery of a cobalt-nickel ore which had been recently discovered in Canada during the building of the Temiscaming and Northern Ontario Railway. These deposits have been described by Mr. W. G. Willer, provincial geologist of the bureau of mines of Ontario.[a] Four finds have been located in the vicinity of a small body of water which is known locally as Long Lake in the township of Bucke. All of these four veins carry cobalt with smaller quantities of nickel, and three of them are rich in native silver. The veins are about one-half mile apart, vein No. 2 outcropping about one-half mile southwest of No. 1, and No. 3 the same distance from No. 2, while No. 4 is about one-half mile southeast of No. 2. The rocks through which these veins cut are known in the district as Huronian slate and breccia-conglomerate. The slate is a fine-grained and delicately laminated rock. This and the conglomerate have a slight dip, and the veins referred to cut them almost vertically. The strike of veins Nos. 1 and 3 is approximately northeast-southwest, that of No. 2 northwest-southeast, and of No. 4 east and west. Diabase and gabbros invade these fragmentary rocks in certain portions of the district and apparently underlie a large part of the area, but it has not as yet been determined where the veins penetrate these igneous rocks. The width of vein No. 1, as exposed in the widest opening, is over 6 feet, but the vein matter is more or less mixed with the rock. This ore is composed of niccolite (arsenide of nickel), smaltite (diarsenide of cobalt), and considerable native silver. Other minerals occurring sparingly with the above are arsenolite; dyscrosite, the antimonial silver; and chloanthite, an arsenide principally of nickel with some cobalt. No samples of the ore have been taken from this vein, so that it is not definitely known what the run-of-mine ore will assay. It can, however, be rather readily concentrated, partly by hand cobbing. A small sample was assayed which consisted essentially of niccolite with only a small amount of the gangue mixed with it. This gave the following results:

Partial analysis of niccolite ore from Canada.[a]

Constituent.	Per cent.	Constituent.	Per cent.
Nickel (Ni)	26.64	Arsenic (As)	45.64
Cobalt (Co)	6.16	Silver (Ag)	[b]5.02

[a] By Mr. A. G. Burrows, Bureau of Mines, Ontario. [b] Ounces.

Vein No. 2 has been developed for a length of over 300 feet, and as exposed the massive ore has a width of over 14 inches, but vugs in the wall rock 2 feet or more from the vein are filled with cobalt bloom. The walls of the vein are well defined. The ore consists principally of a mixture of smaltite with niccolite and perhaps safflorite. Two average samples of the ore were collected by Mr. W. G. Miller, one

[a] Rept. Bureau of Mines, Ontario, 1904, part 1, pp. 96-103.

from the uppermost opening and the second from the middle or main opening. These samples have been analyzed by Mr. A. G. Burrows, with the following results:

Analyses of cobalt ore from Canada.

Constituent.	Sample 1.	Sample 2.	Constituent.	Sample 1.	Sample 2.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
Cobalt (Co)	16.76	19.80	Sulphur (S)	3.37	4.09
Nickel (Ni)	6.24	4.56	Insoluble	....	2.40
Iron (Fe)	....	6.20	Water (H_2O)	....	2.00
Arsenic (As)	66.60	60.30			

In vein No. 3 the ore consists principally of smaltite and cobalt bloom, with native silver and probably niccolite. A small sample of ore from this vein, which would represent approximately the value of the concentrates, was analyzed by Mr. Burrows, with the following results:

Analysis of cobalt-silver ore from Canada.

Constituent.	Per cent.
Silver	11.10
Gold	
Cobalt	15.08
Nickel	5.56
Arsenic	49.68
Sulphur	2.55
Iron	6.38
Insoluble	5.50
Undetermined water, etc	4.15

As exposed, vein No. 4 is smaller in width than either of the other three, and averages not more than 8 inches. This vein is very prominently exposed in a bare cliff of rocks 60 to 75 feet high, which rises nearly perpendicular. The vein cuts this face at right angles and has an almost vertical dip. The vein has weathered, leaving a crack in the face of the cliff from 2 to 5 feet in depth. Thin leaves of silver up to 2 inches in diameter were lying on the edges of the decomposed vein matter, which was cemented together by this metal. The vein had weathered badly, so that it was impossible to obtain fresh samples of the vein material. The specimens obtained showed cobalt bloom in addition to the native silver, and thus the unaltered ore will very probably be found to consist of smaltite and niccolite in addition to the silver. Samples of this weathered ore were analyzed by Mr. Burrows, and the results are given below. The first three analyses are of ore in which the native silver was distinctly visible, and No. 4 was of an ore which appeared to be more weathered than the other three and in which the silver was less prominent. This sample was greenish to yellowish in color and had an earthy appearance.

Analyses of silver-cobalt ore from Canada.

Constituent.	Sample 1.	Sample 2.	Sample 3.	Sample 4.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Silver	23.97	27.00	26.24	16.60
Cobalt	2.85	2.80	8.34	3.91
Nickel	.97	1.00	5.26	1.42
Arsenic	18.30	19.30	13.28	19.79

The high percentage of arsenic in these ores may interfere with their reduction, and this will be especially true if the arsenic is in the form of arsenates.

These deposits lie about 90 miles northeast of Sudbury and Copper Cliff, where are located the Sudbury nickel deposits already described.

ARGENTINA.

Another cobalt deposit that has been recently discovered is at Valla Hermoso, Vinchina, Provincia de la Rioja, Argentina,[a] which has been worked in a small way during the last year. The ore occurs on the western slope of the Cerro de Famatina, a spur of the Andes, in a talcose schist, usually near its contact with an acid, igneous rock. A number of veins appear at the surface, but only one has been exploited. This vein has been opened at three different points by means of tunnels, two of which followed the vein and the third was crosscut from the side of the hill to the vein. The ore body varies in width from 90 cm. to 1.3 m., with an average of about 1.1 m. The ore consists of cobaltite (cobalt glance) mixed with arsenopyrite (arsenical pyrite) in a gangue of quartz. At the present time, as this ore is mined, it is hand-cobbed into first- and second-class ores. Assays[b] have been made of the first- and second-class ores that have been sorted in this way, the results of which are as follows:

Assays of cobalt ore from Argentina.

Constituent.	First-class ore.	Second-class ore.
Cobalt .... per cent..	6.0- 7.0	3.0- 4.5
Nickel .... do....	.5- 2.5	.1- .8
Gold .... grams per metric ton..	25.0- 30.0	10.0- 20.0
Silver .... do....	150.0-300.0	90.0-180.0

There have been about 300 tons of ore already produced, of which 150 tons have been hand-cobbed, and of these only a few tons were

[a] Eng. and Min. Jour., Aug. 4, 1904.
[b] Eriksson, O. S., Eng. and Min. Jour., Aug. 4, 1905.

first class, the bulk of the ore being second class. It is reported that the ore is readily concentrated, so that the entire output of the mine can be brought up to a first-class ore. This would of course permit the utilization of all the low-grade ore, which is now being thrown on the dump.

The distance of this property from Nonozasta, which is the nearest railway station on the F. C. A. Del Norte line, is 120 miles. At the present time nearly all the transportation between this railroad point and the mine is made by pack mules. In some respects this ore is similar to that just described from Canada, and could be classed as a gold-cobalt ore. All the ore that has been concentrated has been shipped to England.

The occurrence of cobalt ores in the Transvaal has been described by Dörffel and C. B. Horwood as occurring in the Balmoral district.[a] They occur in a rock which is now of a quartzite nature, but which Mr. Horwood believes to have been an igneous rock of granitic character. The veins carrying the cobalt vary in thickness from a few inches up to 2 feet, and the ore consists of quartz, feldspar, and a ferro-magnesian mineral, together with smaltite, which is disseminated in small bunches and stringers through this gangue.

There is one peculiar thing noticed in connection with the nickel and cobalt industry and that is that nearly all of the metallic nickel and cobalt oxide that are used in the arts is not produced at those places where the ore itself is mined. Thus the ores of Sudbury, Canada, are treated and smelted to a matte, and the larger part of the matte obtained from these Sudbury ores is shipped to the United States, where it is refined and the pure nickel and cobalt oxide obtained. The New Caledonia ores are either partly smelted or shipped as concentrates, these being sent to the United States, France, England, and other European countries. A notice has recently appeared that a smelting company[b] has been organized to erect a smelter in New South Wales to treat the New Caledonia nickel ores.

There have recently been published two methods for the detection or separation of cobalt and nickel, which seem to give good satisfaction for determining quickly cobalt and nickel in the presence of each other. The first method, which is described by Mr. R. L. Taylor,[c] is a volumetric determination, and consists in the precipitation of the cobalt from a neutral solution as a black oxide, by adding barium or calcium carbonate in the presence of bromine. The oxide precipitated is represented approximately by the formula Co_7O_{14}, or Co_7O_{11}, and Mr. Taylor believes that the composition of this oxide is sufficiently

[a] Trans. Geograph. Soc. S. Africa, vol. 8, 1903, p. 93; vol. 9, 1904, p. 110; and Eng. and Min. Jour., Nov. 10, 1904.

[b] Iron and Mach. World, Sept. 17, 1904.

[c] Chemical News, 1903, p. 184; Eng. and Min. Jour., Dec. 5, 1903.

uniform for the determination of the cobalt by estimating the amount of bromine set free. The time required for this determination is from five to ten minutes. The other method is described in the Zeitschrift für Angewandte Chemie.[a] This separation is brought about by electrolysis, which must be carried on in a hot solution and with a current of about 2.3 volts and with from 0.1 to 0.15 ampère. A platinum cathode is used and potassium bichromate is added to act as a depolarizing agent. The cobalt forms a dark deposit on the platinum anode. This method is specially adapted for the detection of small quantities of cobalt in the presence of nickel.

METALLIC NICKEL AND NICKEL ALLOYS.

The uses of metallic nickel and nickel alloys were taken up in detail in the report for 1903. The greatest use of this metal is in the manufacture of nickel and nickel-chromium steels, the larger part of which is employed in the manufacture of armor plate. The properties of nickel steel or nickel-chromium steel that make it especially adapted for use in the manufacture of armor plates are its hardness, great tensile strength, combined with great ductility and a very high limit of elasticity, and the fact that when perforated by a projectile it does not crack. The alloys of nickel and iron are forgeable regardless of percentage of either metal.

In a recent report issued by the United States War Department[b] a description is given of a series of experiments in regard to the tensile strength of carbon steel and nickel steel ingots made on unforged bars after treatment by heating and quenching, and also of tests on bars drawn down under the hammer at different temperatures. The results of these experiments show the nickel steel to be much greater in tensile strength than the carbon steel. The carbon steel ingot examined contained, besides iron, 0.2 per cent carbon, 0.58 per cent manganese, 0.015 per cent silicon, and 0.017 per cent phosphorus. The nickel steel ingots contain besides iron, 3.25 per cent nickel, 0.17 per cent carbon, 0.68 per cent manganese, 0.016 per cent silicon, and 0.01 per cent phosphorus. A nickel steel was also tested that contained, besides iron, 30.3 per cent nickel, 0.11 per cent carbon, 0.56 per cent manganese, 0.01 per cent silicon, 0.025 per cent sulphur, 0.06 per cent phosphorus, 0.06 per cent copper. In the table which follows some of the results obtained for tensile strength on these two nickel steels are given.

[a] Zeitschr. für angewandte Chemie, vol. 33, p. 9, and Eng. and Min. Jour., Jan. 7, 1904.
[b] Tests of Metals, etc., 1903, pp. 169–309, and 401–408.

Tabulation of tensile specimens from 16 by 18 inch nickel-steel ingot containing 3.25 per cent nickel.

[Stems of specimens 0.564 inch diameter, 3 inches long.]

Treatment.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3 inches.	Contraction of area.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*
Heated straw color and cooled in dry sand. Subsequently heated to 500° F. in hot oil for a period of four hours	34,000	66,400	21.7	36.4
Heated blue and cooled in dry sand	35,000	66,000	21.3	36.4
Heated red and cooled in dry sand	35,000	63,200	10.0	18.3
Heated cherry and cooled in dry sand	33,000	64,000	10.3	21.4
Heated low yellow and cooled in dry sand	54,000	73,280	27.0	49.7
Heated bright yellow and cooled in dry sand	45,000	71,600	25.3	39.2
Heated white hot and cooled in dry sand	39,000	67,600	11.0	24.6
Raised to scintillating heat and cooled in dry sand	39,000	64,000	7.0	21.4
Heated white hot and quenched in—				
Oil	(a)	119,800	1.0	1.5
Brine	(a)	189,000	4.3	[b]9.5
Heated white hot, quenched in oil, and annealed at—				
Straw color	(a)	153,600	1.3	5.0
Blue heat	(a)	126,400	1.0	5.0
Bright cherry	51,000	63,920	7.3	24.6
Bright yellow	45,000	63,600	8.3	21.4
White heat	40,000	71,680	27.7	57.0

[a] Indefinite. [b] Diameter of stem, 0.505 inch.

Tabulation of tensile specimens from 30 per cent nickel-steel billet.

[Stems of specimens, 0.564 inch diameter, 3 inches long.]

Treatment.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.
Heated cherry and quenched in—	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*
Brine	15,000	65,680	43.0	75.4
Oil	15,000	64,800	44.3	75.4
Heated bright yellow and quenched in—				
Brine	17,000	65,600	42.7	71.7
Oil	17,000	65,600	43.7	71.7
Heated white hot and quenched in—				
Brine	17,000	65,680	40.7	71.7
Oil	16,000	63,680	43.3	73.6
Natural state	22,000	68,000	41.7	71.7

The commercial nickel alloys vary considerably, and those quoted by George G. Blackwell Sons & Co., Limited, of Liverpool, England, contain 25, 50, and 75 per cent nickel, with 75, 50, and 25 per cent iron and one-half per cent or less of carbon. One of their chromium-nickel alloys, which seems to have the greatest use, contains from 50 to 52 per cent chromium, 17 to 20 per cent nickel, and 0.4 to 0.8 per cent carbon. Other alloys of nickel and chromium contain 25 per cent of nickel, and 50 per cent nickel and 50 per cent chromium.

There are a number of ferro-nickel alloys that have been found in nature which are rather of mineralogical interest than of economic importance. Some of these are considered of meteoric origin, while three are considered to be of terrestrial origin. These native ferro-nickel alloys are given in the following table:

Native ferro-nickel alloys.

Name of mineral.	Iron.	Nickel.	Formula.	Specific gravity.
	Per cent.	*Per cent.*		
(1) Catarinite	63.69	33.97	Fe_2Ni	
(2) Octibbehite	37.69	59.69	Fe_2Ni_3	
(3) Awaruite	31.02	67.63	Fe_2Ni_4	8.1
(4) Josephinite	23.22	60.45	Fe_2Ni_5	
(5) Nickel iron	26.6	[a] 75.2	$FeNi_3$, or Fe_2Ni_6	7.8
(6) Souesite	22.30	76.48	Fe_2Ni_7 ?	8.215

[a] Contains very little cobalt.

As is seen from this table, these natural ferro-alloys arrange themselves into a group in which the nickel content increases constantly by one. The only member of this group of natural alloys wanting is one which would correspond to the formula Fe_2Ni_2. Of these native ferroalloys, the first two, catarinite[a] and octibbehite,[b] have been ascribed to meteoric origin. The awaruite has been found in the drift of the Gorge River, a stream flowing into Awarua Bay on the west coast of the middle island of New Zealand. Associated with this mineral in the drift material are gold, platinum, cassiterite, chromite, and magnetite. Josephinite[c] is a mineral which forms the metallic portion of ellipsoidal pebbles (specific gravity, 6.204), the metallic portion being malleable and sectile. This material occurs in placer gravel on a stream in Josephine and Jackson counties, Oreg.

The nickel iron given above is a native nickel-iron alloy, which has been found in auriferous sands of the stream Elvo, near Biella, in Piedmont. There has been no special name given to this natural alloy and it is referred to here as nickel iron. The last of these nickel alloys, souesite,[d] has recently been described by Mr. G. C. Hoffman, who states that it was obtained while dredging for gold in the Fraser River, two miles below Lillooet, Lillooet district, in the Province of British Columbia. It was obtained as an aggregate of very small, irregularly shaped, rounded grains, and has been found but sparingly.

[a] Encyclopédie Chimique, Frémy, Metalloids, vol. 2, par M. Stanislas Meunier, and Am. Jour. Sci., 3d ser., vol. 43, 1892, p. 514.

[b] Am. Jour. Sci., 2d ser., vol. 24, p. 293.

[c] Am. Jour. Sci., 3d ser., vol. 43, 1892, p. 509.

[d] Am. Jour. Sci., 4th ser., vol. 19, 1905, p. 319.

CHROMIUM.

SOURCES OF SUPPLY.

The chief sources of supply of chromite, which is the mineral from which all of the metallic chromium and chromium salts are obtained, are deposits in New Caledonia and in European and Asiatic Turkey. Other countries in which chromite is mined in much smaller quantities are Quebec and Newfoundland in the Dominion of Canada, Greece, Russia, Australia, India, and the United States. The deposits in the United States which are at the present time producing this mineral are located in California, but the production has only amounted to a few hundred tons for the last few years.

The New Caledonia deposits are controlled largely by the Société le Chrome, and the principal district in which the ore is now mined and where it is especially rich is Tiepaghi.

The United States draws its principal supply of chromite from the Provinces Macri and Broussa, in Asiatic Turkey. These ores vary from 54 to 58 per cent chromic oxide, Cr_2O_3. A certain amount of ore is also imported from New Caledonia, where ore has been obtained whose chromic oxide content was 56 per cent. Smaller quantities are also imported from Newfoundland and Australia.

CHROMIUM AND CHROMIUM ALLOYS.

The largest use of chromium is in the form of the ferro-chromium alloy, and the metal chromium used in the manufacture of chrome steel, which in turn is used in the manufacture of armor plate, usually in combination with nickel, as mentioned under "Nickel." In the report for 1903 the statement was made that in the manufacture of chromium steel it was more advantageous to use the ferro-chromium alloy than the chromium metal. This was true when the chromium metal was first introduced on the market and may have been due to the carbon content of this metallic chromium, which made it more difficult to fuse. During last year, however, metallic chromium free from carbon has been produced by the alumino-thermit process, and, according to a private communication, it is now being used, especially abroad, in the manufacture of chromium steel; and while there is a difference in fusibility between the ferro-chromium and the pure chromium, it is not sufficiently great to be an impediment in the use of the metal chromium for the manufacture of chromium steel. It may be that the pure metal will have approximately as low a fusibility as a ferro-chromium containing a small percentage of carbon. One thing that would probably be in favor of the metallic chromium would be its uniform composition. The price of chromium metal free from carbon is considerably higher than the ferro-chromium alloys produced in the electric furnace. A carbon-free chromium containing 97 to 98 per cent metallic chromium is now made by Th. Goldschmidt, at Essen-Ruhr, Germany, by the alumino-thermit process and is beginning to be used quite extensively in Europe and also in the United States. The metal thus prepared contains as impurities traces of iron and silicon. It is a brittle metal, remaining bright indefinitely, and with a melting point higher than that of platinum.

There are a number of alloys of chromium. Those made by the alumino-thermit process at Essen-Ruhr, Germany, are a chrome-manganese alloy free from carbon, containing 30 per cent of chromium and 70 per cent of manganese; a chrome-molybdenum alloy free from carbon, containing 50 per cent of chromium and 50 per cent of molybdenum, and a chrome-copper alloy free from carbon, containing about 10 per cent of chromium. A ferro-chromium alloy has been made by the Rossi process, which has the following composition: Chromium, 68.24 per cent; iron, 26.92 per cent; silicon, 1.85 per cent; carbon, 1 per cent; aluminum, 0.5 per cent. The ore from which this ferro-chrome was made gave the following analysis:

Analysis of chromium ore.

Constituent.	Per cent.	Constituent.	Per cent.
Cr_2O_3	50.29	CaO	1.15
Fe_2O_3	16.01	S	.01
Al_2O_3	10.72	Moisture	1.4
SiO_2	4.62	Total	100.81
MgO	16.61		

The manufacture of the ferro-chromium alloys can be accomplished in the electric furnace, the crucible furnace, or the blast furnace, but at the present time it is made almost exclusively in the electric furnace. Formerly, before the converting of our water powers into electric power, the principal method of making ferro-chrome was in blast furnaces. By this process only a low-grade ferro-chrome alloy could be obtained, the chromium content being from 30 to 40 per cent. With the introduction of the electric furnace, however, for the manufacture of these alloys, the chromium content has been increased to 60 per cent and upward, and at the present time the alloys that seem to be in the greatest demand are those containing 60 per cent or more of chromium. The main objection to the use of crucible furnaces is that only small quantities of the ferro-chrome alloy can be prepared at one time, but the chromium content is very high. Ferro-chrome alloys are now being prepared in large quantity by means of the electric furnace in the United States, in France, and in Germany. Where formerly these ferro-alloys were apt to contain a rather high percentage of carbon, the processes have now been so improved and regulated that ferro-chrome alloys can be made that contain but a fraction of a per cent of carbon, and the product can now be made approximately uniform.

Some of the principal firms manufacturing ferro-chrome alloys are the Wilson Aluminum Company, at Kanawha Falls, W. Va., and Holcomb Rock, Va.; Chrome Steel Works, Brooklyn, N. Y.; the Hecla Works, Sheffield, England; George G. Blackwell Sons & Co., Limited, Liverpool, England; and Hugo Krupp, Hanover, Germany. In France there are a number of plants manufacturing ferrochrome, as follows:[a] Société Electrométallurgique française, at La Praz; Société La Néo-Métallurgie, at Giffre; Société Anonyme Electrométallurgique, at Albertville; Keller, Leleux & Cie., at Livet; Société Electrométallurgique de Saint-Béron, at Saint-Béron; Ch. Betrolus, at Bellegarde, and Rochette Frères, at Epierre.

There are various forms of electric furnaces used in the manufacture of the ferro-chromium alloys. Perhaps one of the simplest types of furnace is that used by the Wilson Aluminum Company, in which the crucible constitutes one of the electrodes, and these furnaces are of partly circular, partly square, and partly rectangular cross section. Their outside dimensions vary from 120 inches wide, 80 inches long, and 60 inches high of the largest to 60 inches square and 50 inches high of the smaller ones. The furnaces consist of iron boxes with very thick linings of pieces of anode carbon with tar binder, and they are provided with tapping holes. In a few of the furnaces the lining constitutes one electrode, while the other is formed by a bar of carbon which hangs vertically in the furnace. Others have two parallel electrodes, which hang vertically in the crucible and are movable. In this latter type the crucible is not connected into the electric circuit. These hanging electrodes consist of carbon bars 60 inches in length, with a cross section of 4 by 4 inches, one electrode being formed by two bars side by side. These electrodes are fastened into the iron heads, which are kept cool by means of water. As these furnaces are used the carbon lining is gradually replaced by material of the melt, until finally the crucible is practically lined with the same material as that which is melted. An alternating current of 110 volts pressure and of 22,000 amperes is divided on seven different furnaces. The energy consumed in the production of these ferro-chrome alloys is about 10.6 estimated horsepower hours per kilogram of the product obtained.

This company is making ferro-chrome principally from Turkish and New Caledonia ores, with smaller quantities from Canadian and Cuban ores.

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[a] Electrochemical Industry, vol. 2, 1904, p. 450.

Typical analyses of these four chromite ores are given in the table below:

Analyses of chromite ores.[a]

Constituent.	Turkish ore.	New Caledonia ore.	Canadian ore.	Cuban ore.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Chromic oxide	50.30	54.50	50.00	50.00
Ferrous oxide	15.50	17.70	19.50	18.57
Alumina	13.10	11.00	Undet.	12.44
Silica	7.00	3.10	4.90	3.82
Lime	14.10	1.60	11.00	2.16
Magnesia		8.00		13.38

[a] Chemist of Wilson Aluminum Company, analyst.

In the next table there is given a series of analyses of some of the ferro-chrome alloys on the market.

Analyses of ferro-chromium alloys.

Constituent.	1.	2.	3.	4.	5.	6.	7.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Chromium	67.00	71.98	66.00	64.05	63.586	69.60	60.00
Iron	24.38	22.61	28.60	25.45	35.596	28.452	35.00
Carbon	8.05	4.789	4.90	8.55	.650	1.56	1.00
Silicon	.490	.550	.50	1.88	.140	.350	....
Sulphur	.007	.061	....	.046	.028	.038	....
Phosphorus	.005	.008	....	.025	Trace.	Trace.	....
Total	99.932	99.998	100.00	100.001	100.000	100.000	96.00

1. Crystalline ferro-chromium alloy manufactured by the Wilson Aluminum Company.
2. Solid ferro-chromium alloy manufactured by the Wilson Aluminum Company.
3. Ferro-chromium alloy obtained from Canadian ore and manufactured by the Wilson Aluminum Company.
4. Ferro-chromium alloy manufactured by George G. Blackwell Sons & Company (Limited).
5. Ferro-chromium alloy, refined No. 1, manufactrued by George G. Blackwell Sons & Company (Limited).
6. Ferro-chromium alloy, refined No. 2, manufactured by George G. Blackwell Sons & Company (Limited).
7. Approximate composition of ferro-chromium alloy manufactured by the Société la Néo-Métallurgie. Carbon content ranges from .4 to 1 per cent.

There are a number of alloys of chromium with iron and nickel described under "Nickel."

Besides these, there is a patented ferro-chromium nickel alloy manufactured by the Société la Néo-Métallurgie whose composition is as follows: 16 to 38 per cent of iron; 24 to 57 per cent of chromium; 5 to 60 per cent of nickel; 0.30 to 0.80 per cent of carbon, with a very small amount of silicon and traces of sulphur and phosphorus. This company also manufactures a ferro-chromium silicon alloy which contains 50 per cent of chromium, 38 per cent of iron, 8 to 10 per cent of silicon, and 2 per cent of carbon.

The values of these ferroalloys vary considerably not only according to their percentage of chromium, but also according to the quantity of carbon that they contain. There has been considerable agitation among the manufacturers of ferro-chromium regarding the duty on ferro-chrome alloys. At the present time ferro-chrome is dutiable at the rate of $4 per ton, but it is contended by some of the manufacturers of ferro-chrome that the proper duty on this alloy should be levied and collected according to paragraph 183 of the act of 1897 at the rate of 20 per cent ad valorem.

TUNGSTEN.

SOURCES OF SUPPLY.

Tungsten is one of the steel-hardening metals which has been used to some extent in the manufacture of hardened steel for armor plate and heavy guns, but principally in the manufacture of tool steel. There has been an increasing demand for this metal during the last year or two, and also an unusual amount of prospecting for tungsten ores, which has resulted in the discovery of a number of new localities where these ores are to be found in greater or less quantity. Thus tungsten, which was formerly considered one of the rather rare elements, has been proved to occur in large quantity and to be rather widespread in its occurrence. The minerals which constitute the ores of tungsten are:

1. *Wolframite.*—This is a dark-gray, grayish-black, to deep brownish-black mineral with a submetallic to resinous luster. Its specific gravity is 7.2 to 7.5, and its hardness 5 to 5.5. The mineral crystallizes in the monoclinic system and is often found in terminated crystals. It is very brittle, having a perfect cleavage parallel to the pinacoid face, but an uneven fracture. It is more commonly found massive with a more or less granular structure. The chemical composition of the mineral is a tungstate of iron and manganese $(Fe\ Mn)\ WO_4$. It fuses easily before the blowpipe to a globule having a crystalline surface, which is sometimes magnetic. The high specific gravity of this mineral is very noticeable, and if it is in pure masses, the specific gravity will be of considerable assistance in identifying the mineral. This property, together with its dark-colored streak, with a brownish or reddish tinge, its hardness, and the fact that it is easily fusible, should be means of readily identifying it and prevent confusing it with other minerals such as magnetite, hematite, rutile, cassiterite (tinstone), titanic iron, tourmaline, etc.

2. *Hübnerite.*—This mineral is very similar to wolframite, but usually occurs in bladed forms and has a decided brownish-red to nearly black color, while the former is more commonly grayish-black. Its chemical composition differs from that of wolframite in that the iron has been largely replaced by manganese, and it is essentially a

manganese tungstate, $MnWO_4$. It is less fusible before the blowpipe than wolframite and gives a very strong manganese reaction with either sodium carbonate or borax.

3. *Scheelite.*—This is a very heavy, white to yellowish-white mineral, with an adamantine to vitreous luster. Its specific gravity is 5.6 to 6.1, and its hardness is 4.5 to 5, it being readily scratched by steel. It crystallizes in the tetragonal system, but is more commonly found massive. Its chemical composition is calcium tungstate, $CaWO_4$. Before the blowpipe scheelite fuses with difficulty to a semitransparent glass. It is readily decomposed by hydrochloric or nitric acids, leaving a yellow powder which is soluble in ammonia. There are a number of minerals which in appearance are very similar to scheelite, these being cerussite, a carbonate of lead; anglesite, a sulphate of lead; barite or barytes, a sulphate of barium, and witherite, a carbonate of barium. These minerals can all, however, be readily distinguished from scheelite by simple chemical tests, as the two lead minerals and the barium carbonate are readily fusible, and the two barium minerals give readily a green flame, due to barium oxide, when heated before the blowpipe. The scheelite is so much heavier than either of these two barium minerals that its specific gravity alone, if one is familiar with the scheelite, should readily prevent any confusion. The two lead minerals are so apt to be associated with galena that it is doubtful if there would be very much tendency to confuse them. The best method of familiarizing one's self with these tungsten minerals is to obtain specimens of each one. This applies especially to those who intend to prospect for them.

Besides these three minerals, which up to the present time have been the sources of supply of the metal tungsten, there are a number of other minerals which contain a considerable percentage of tungsten, but have thus far been found only in small quantities and at a few localities. These minerals are: Cupro-tungstite, a tungstate of copper, $CuWO_4$, which passes into a tungstate of copper and calcium, $(CaCu)WO_4$, and is a highly vitreous mineral of pistachio-green color, occurring in crusts; stolzite, a lead tungstate, $PbWO_4$, found sparingly in tetragonal crystals, of a green to brown or red color; tungstite, or tungstic ocher, a trioxide of tungsten, WO_3, which occurs with wolframite at a number of localities where the tungstite has been found filling small cavities in the wolframite, or cutting it, and has very probably resulted from its decomposition, a pulverulent and earthy mineral of a bright yellow to yellowish-green color; and meymacite, a hydrated tungsten oxide formed from the alteration of scheelite.

In assaying a tungsten ore it is essential not only to determine the percentage of tungstic oxide in the ore, but also the phosphorus, sulphur, and arsenic that it may contain, as well as carbon and silica.

These latter, however, are not necessarily to be considered injurious, except the carbon; if there is any of this element in the ore, it would be difficult to obtain a carbon-free tungsten metal or ferro-tungsten alloy.

The present market price in New York for tungsten concentrates carrying at least 60 per cent WO_3 and containing not more than 0.25 per cent phosphorus and 0.01 per cent of sulphur is quoted at $7 per unit of tungstic acid, or $420 per long ton. With an increase in the percentage of tungstic oxide in the concentrates, a rate of $7.50 per unit has been quoted. The prices given for these tungsten concentrates in the table of production is the value of these concentrates at the points where they are produced.

A recent method has been suggested by E. Krahn[a] for the determination of tungsten in steel. Two grams of the steel to be analyzed are dissolved in a mixture of equal parts of sulphuric and phosphoric acids with 3 pints of water. To this mixture there is added from time to time, while the steel is being dissolved, 3 c. c. of potassium permanganate. When the solution has become cold, it is divided into two portions. To one portion there is added 200 c. c. of sulphuric acid (1 to 3) and 40 grams of zinc shavings. The solution is heated and then allowed to cool in a current of carbon dioxide. Any excess of zinc is filtered off, and the filtrate is then triturated with permanganate. In the second portion, iron can be determined by the Reinhardt method, or with stannous chloride and iodine, and the tungsten can be estimated by difference.

OCCURRENCES.

The first demand for the metal tungsten was supplied by tungsten ores from Cornwall and Cumberland, England. With the increasing demand for the metal, other deposits were soon located; and before there was any development of any tungsten properties in the United States, these ores were being obtained from England, Austro-Hungary, Saxony, Germany, and Australia, and at that time what tungsten was used in the United States was imported. During the last few years considerable interest has been aroused among prospectors and others in this country regarding the occurrence of tungsten minerals, and sufficient deposits of these minerals have been discovered to supply a great deal more ore than is demanded by the home consumption, and the United States is now in a position to export these ores in large quantities.

The general occurrences of tungsten can be divided roughly into three general groups somewhat as follows:

(1) Those in which the tungsten minerals are more or less closely associated with ores of tin in greisen and as constituents of pegmatitic

[a] Stahl und Eisen, Jan. 1, 1904, and Eng. and Min. Jour., March 3, 1904.

dikes. Deposits of this character have been found in Cornwall, England, and in the Black Hills, South Dakota.

(2) Deposits in quartz and related veins that have been found in granite and rocks of similar character and that are in no way associated with tin ores. Veins of this character are those in the Dragoon Mountains of Arizona, near Osceola, Nev., etc.

(3) Tungsten ores associated with limestone, as those near Lead, S. Dak.

No strong line of demarcation can always be drawn between these groups, and very often they so grade into each other that an occurrence can sometimes be ascribed to two of the groups.

The greater number of the localities where these minerals have been found are in the Western States, the principal deposits being in Arizona, Nevada, and Colorado. The other Western States in which tungsten deposits have been found, although worked to but a small extent, are Idaho, Montana, New Nexico, Oregon, South Dakota, and Washington. In the Eastern States the principal deposits are located in Connecticut, and a very small quantity has been found in North Carolina.

ARIZONA.

There were quite extensive operations conducted during 1904 on the tungsten deposits in Cochise County, Ariz. These deposits occur 13 miles from Benson and 6 miles north of Dragoon in the Little Dragoon Mountains. This area has been pretty thoroughly prospected for tungsten ores by means of open cuts, pits, shallow shafts, etc. These prospect cuts and pits have been made on a long ridge, in the gulches of which placer and float tungsten minerals have been found. The occurrences of the tungsten minerals have been described by Mr. Forbes Rickard.[a] He states that the occurrences of the tungsten minerals are as follows:

(1) Tungsten ore, composed principally of hübnerite, which occurs in aplite veinlets and crystalline quartz that occupy fissures in the main body of the granite constituting the country rock.

(2) In the second occurrence the tungsten ore consists of hübnerite and wolframite which are due to the alteration of the incasing wall rock and flank the vein itself, sometimes on one side and sometimes on both sides of the vein.

The demarcation between vein and vein walls is not generally distinct and the transition is more often gradual. Scheelite has occasionally been found in small seams and streaks with the hübnerite. The deposits near the surface have been more or less decomposed. The belt containing these veins is the ridge at the head of Texas ridge and Sheep Canyon. The trend of the various veins is approximately that

[a] Eng. and Min. Jour., Aug. 18, 1904, p. 263.

of the ridge N. 40° E., and they have a dip of about 70° S. There has been considerable work done on this ridge by running in crosscuts and tunnels to intercept these veins, but many of the lower tunnels which were run in sufficient distances to have intercepted the vein if it existed found no trace of it at these lower depths, with the exception of the Bluebird vein, which seems to be more continuous than the others. This vein occurs at the contact of granite and intrusive diorite. It has a strike of N. 50° E. and dips 55° to 60° toward the east and is on the hanging wall side of the diorite dike. The tungsten minerals in these veins are very apt to occur in bunches and also in streaks, so that a large proportion of the vein contains little or no tungsten minerals. In some instances where the vein is a number of feet in width, the tungsten minerals have been concentrated in seams 5 to 6 inches in width; then again, rich bunches of hübnerite ore from a few pounds to nearly 4 or 5 tons of nearly pure ore, averaging from 50 to 60 per cent tungstic acid, have been obtained. The supply of tungsten ore from this locality has been obtained from the veins, and also from the placer deposits in the gulches below the veins, and it is probable that by far the larger part has been obtained from these placer deposits. One estimate made of the production of this locality has been 500 tons of tungsten ores, of which not over 50 tons have been obtained from the veins themselves, the balance being the result of mining in the placers. The percentage of tungsten in these ores varies from 50 to 78 per cent, and usually it can be readily concentrated so that the ore will yield an average of 68 per cent of tungstic acid, WO_3.

Another locality in Arizona where tungsten ore has been found and mined in some quantity is in the Arivaca district, in Pima County. It has also been found 60 miles south of Hackberry, Mohave County, where seams of wolframite from 2 to 6 inches in thickness are found in quartz veins which are 1 to 3 feet wide.

COLORADO.

The tungsten deposits of Colorado are located in Boulder, Gilpin, Lake, Ouray, and San Juan counties, with the more important deposits in the first-named county. The deposits in Boulder County are in the vicinity of Nederland and Sugar Loaf, and these localities produced by far the largest proportion of the tungsten output of 1904. According to the reports received from the producers in this county, the ore concentrated on the average 10 tons into 1, the concentrates averaging from 60 to 68 per cent of tungstic oxide. Practically all of these concentrates are shipped east, where they are treated chemically and reduced to the black tungsten metal or powder. Other portions are used directly in the manufacture of the fused metal or in the ferro-tungsten alloy.

NEVADA.

The tungsten deposits in this State are in the foothills on the west slope of the Snake Mountains, near the base of Wheeler Peak, and about 12 miles south of Osceola. On account, however, of the distance of these deposits from the railroad, the nearest point being Frisco, Utah, on the Oregon Short Line Railway, about 100 miles distant, there has been no shipment of ores from these deposits, and most of the work has been the annual assessment work. Recently these deposits have passed into the control of the Tungsten Mining and Milling Company, which has worked them during the past year. The company has taken out about 80 tons of ore, but has not concentrated any of it. The tungsten mineral is hübnerite and occurs in veins of quartz, which vary from a few inches to a number of feet in width, being normally about 3 feet wide, but pinching in places to a few inches. The main vein or deposit can be traced for a distance of 2,100 feet by means of outcroppings and of float and is composed principally of milky white quartz and hübnerite. The vein, which cuts across the porphyritic granite, is composed of quartz, mica, and hornblende, has a strike of N. 68° E., and dips 65° NW. The hübnerite occurs in solid masses up to 16 and 12 inches in thickness, and also in disseminated particles or blade-like forms through the quartz and occasionally in groups of crystals intermingled with quartz crystals. Occasionally small apophyses of ore are found penetrating out into the country rock. It should be an easy matter to concentrate this ore, as it crushes readily, and the hübnerite could undoubtedly be easily concentrated by jigging.

WASHINGTON.

In Stevens County, Wash., near Deer Trail, wolframite occurs in the properties of C. S. Palmer, of Deer Trail, and of the Roselle Mining Company, which is mining this mineral at Roselle Camp. The deposits are 27 miles from the railroad. The ore concentrates well and will give a product containing about 68 per cent GWO_3.

SOUTH DAKOTA.

The tungsten deposits in South Dakota are found in the Black Hills in two localities—one almost immediately north of Lead, near the top of the high hill forming the divide between Gold Run and Deadwood gulches, and the other more to the south of Lead, on the divide between Yellow and White Wood creeks. The tungsten mineral is wolframite, and it occurs in an impure dolomite which is very siliceous and grades off almost into a quartzite. The wolframite is found in flat, horizontal, but irregular masses up to 2 feet in thickness, which frequently cover considerable areas, one having been observed which extended from 20 to 30 square feet. They are, however, extremely irregular, and no accurate estimate can be made of their lateral extent. This wolframite ore is considered by Mr. J. D. Irving[a] to be more in the nature of a basic phase of the refractory siliceous ores that are found in this district than as a separate and distinct deposit, for all these tungsten ores have been found in intimate association with the siliceous ores. Occasionally the tungsten minerals form a rim around the outer edge of a siliceous ore shoot, often extending inward and upward so as to form a thin cap to the shoot. At other times the wolframite is found in irregular masses scattered through the siliceous ore or in stringers and thin layers in a partially silicified dolomite. Usually the ore is separated from the nonmineralized rock by a fairly sharp line of demarcation, but occasionally it grades off by scarcely perceptible transitions into the country rock. There is usually a little quartz associated with the wolframite, and in some instances large crystals of barite have been observed. Scheelite has also been occasionally found. A specimen (1) of this ore taken from the Two Strike mine on Yellow Creek and another (2) from the Harrison mine near Lead have been analyzed by Dr. W. F. Hillebrand, in the laboratory of the United States Geological Survey, with the following results:

Analyses of wolframite ore from Black Hills, South Dakota.

Constituent.	1.	2.	Constituent.	1.	2.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
SiO_2	12.87	9.60	$K_2O+Na_2O+Li_2O$	0.08	....
WO_3	61.50	61.70	H_2O, below 105° C	.20	....
Fe_2O_3	3.85	[a] 12.67	H_2O, above 105° C	.87	....
FeO	9.18	....	As_2O_5	1.25	....
Al_2O_3	.52	....	P_2O_5	.12	....
MnO	8.21	7.21	V_2O_5	Trace.	[b] 0.10
CaO	.93	5.39	S or SO_3	Trace.	....
SrO	.02	....	Total	99.64	....
BaO	.04	....			

[a] Determined as Fe_2O_3, includes FeO. [b] Approximate.

As is seen from these analyses, there is some little arsenic and phosphorus in these tungsten ores, but it is not improbable that, in the concentration of the ore and its reduction to the metal or to the ferro-alloy, the percentage of these elements would be so greatly reduced in comparison with the total per cent of iron in the steel in whose manufacture they are used that they would not seriously affect the steel. From these analyses an approximate determination has been made by Mr. Irving as to the mineralogical composition of the ore, which is given in the following table:

[a] Irving, J. D., Prof. Paper No. 26, U. S. Geol. Survey, 1904, p. 164.

Proportions of principal minerals in tungsten ore from Black Hills, South Dakota.

Constituent.	1.	2.	Constituent.	1.	2.
	Per cent.	*Per cent.*		*Per cent.*	*Per cent.*
Wolframite $(FeMn)WO_4$	75.60	51.58	Ferric oxide, Fe_2O_3	3.85	....
Quartz, SiO_2	12.54	9.60	Water, H_2O	.20	....
Scheelite, $CaWO_4$	4.77	27.68	Arsenic oxide	1.25	....
Barite, $BaSO_4$	.06	....	Residual clay (kaolin)	1.34	....

CONNECTICUT.

The Connecticut deposits of tungsten ore are located near Long Hill, Fairfield County, Conn., and a few years ago were developed quite extensively by the American Tungsten Mining and Milling Company, but little work has been done at them during the last two years. The tungsten mineral found in these deposits is principally scheelite, with smaller amounts of wolframite. These tungsten minerals are found near the contact of bodies of diorite and hornblende gneiss with intercalated beds of crystalline limestone, which form a nearly horizontal, waving monocline or gentle syncline. The tungsten minerals are more abundant at the lower contact and are found in zones composed of massive quartz, some zoisite, and epidote, through which the scheelite and wolframite are disseminated in small particles and crystals. Pyrite is also found associated with the wolframite, and has caused some trouble in obtaining a clean tungsten concentrate.

OTHER LOCALITIES.

Other localities where tungsten minerals have been found in the United States are as follows: Neihart, Mont.; near Randsburg, Kern County, Cal.; and in the vicinity of Stein's pass, on the line of the Southern Pacific near the New Mexico-Arizona line; and scheelite from near Murray, Shoshone County, Idaho; from the Virtue district, a few miles east of Baker City, Baker County, Oreg.; and from near Randsburg, Kern County, Cal.

FOREIGN LOCALITIES.

The principal foreign localities containing deposits of tungsten-bearing minerals are Canada, Australia, New Zealand, Great Britain, Saxony, Bohemia, Spain, Portugal, Peru, and Burma. Not all of these deposits, however, have thus far proved to contain the tungsten minerals in commercial quantities, although prospecting is being continued in many of these countries.

AUSTRALIA.

The tungsten deposits of Australia are principally in Queensland and in New South Wales, and also at several localities in western Australia. The Queensland deposits are found in the northern part of the State and are situated about 100 miles west of Cairns, a leading seaport on the Queensland coast, the district being connected by railway with that place. One of the richer tungsten districts is known as Wolfram Camp, and is about 6 miles from the railway station. Other sections in this district where tungsten ores have been found are at Bamford, Lappa Lappa, Tinaroo Creek, and Boonmoo. The ore, which consists chiefly of wolframite, occurs in veins of quartz and especially in the irregular offshoots that penetrate from the main seam of the veins of quartz into the granitic country rock. It has been estimated that the output of tungsten ores from this north Queensland district from 1894 to the end of 1903 is about 930 tons.

The New South Wales tungsten deposits are found distributed over a large part of the State, although the more important are in the northern sections of the State in the tin-mining districts. None of these deposits, however, are as important or as rich as those of northern Queensland. The most extensive development work has been done at Deepwater, in the New England district. The tungsten ore is obtained both from placer deposits and from seams in quartz veins penetrating the granitic rocks. In connection with the tin mining there is occasionally a considerable percentage of wolframite found with the tin concentrates. It has been estimated[a] that the total production of tungsten up to the close of 1903 was about 182 tons.

In western Australia wolframite is reported to have been found in small quantity near Roeburne, in the Pilbarra district, and in the Geraldton district, and scheelite is reported to have heen found in small bunches in Fraser's mine near Southern Cross; in Lindsay mine, near Coolgardie, and in Hannon's Hill, Kalgoorlie. As far as can be learned no tungsten ores have been shipped from these western Australia districts.

NOVA SCOTIA.

There is a deposit of tungsten ore at Northeast Margaree, Cape Breton, Nova Scotia, that was discovered in a ravine between and near the bases of two mountains that attain an elevation of about 800 feet. The vein has been traced across the ravine and for over 200 feet up the mountain. The amount of development work that has been done is small, and consists of short tunnels driven into the mountain which have intercepted the vein. This work has shown that the wolframite occurs very abundantly in certain places of the vein, while it is almost entirely absent in others, this being rather characteristic of other tungsten veins. The gangue rock is almost entirely quartz.

PORTUGAL.

There has been a little tungsten ore produced in Portugal, and during the year 1903 this amounted to 228 metric tons.[b]

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[a] John Plummer Sydney, Mining World, Dec. 3, 1904, p. 543.
[b] Jour. Soc. Chem. Ind., Jan. 16, 1905.

INDIA.

Recently a deposit of tungsten ores in Burma, India,[a] has been described. The deposit is in the Tenasserim district of Burma, due north of Therawih, on the banks of the Great Tenasserim River. The deposits, which are in the form of placers, have been traced for several hundred yards along the beds of three streams, and another deposit has been located by Col. K. M. Foss, which covers an area about 440 yards long by 40 yards wide, in which the tungsten alluvium lies very close to the surface to a thickness of several feet. These deposits are particularly free from tin, containing hardly a trace of it. The ore is very easily washed and concentrated, and, according to the estimate of Mr. Ricketts, the gravels will wash 45 pounds to the cubic yard, or 45 pounds per ton of gravel. These deposits are close to a water route to the sea, which would mean cheap and efficient transportation.

PERU.

In Peru, about 3 leagues from Lircay, capital of the Province of Angaraes, in the Department of Huancavelica, tungsten ores have been found in a deposit that was formerly worked for gold. The tungsten minerals found are wolframite and hübnerite, the assays showing 75 to 76 per cent tungstic acid, 10 to 20 per cent iron oxide, and 4 to 15 per cent manganese oxide. This deposit is situated a long distance from railroad transportation and is best reached by railroad from Lima to Oroya, and then by a three-days' journey on horseback. This deposit has recently been described by Eduardo A. V. de Habich[b] as follows:

> This deposit is found on Julcani hill, near Lircay. It consists of two veins, the upper one known as Rosario and the lower as Las Animas. These veins are nearly vertical, and the rock between them is a network of mineralized veinlets. The ore occurs as lenses of a width of about 1½ meters, and the lenses are united by small stringers. In the Rosario vein, in which the wolframite is in greatest abundance, the ore occurs in large blocks, compact, and 8 to 10 centimeters wide. The ore is also found in bands along the sides of the rock which forms the vein material, and which is a ferruginous quartz. In other places in the same vein flat crystals of wolframite are scattered sparsely in the quartz, accompanied at times by flakes of native gold; and again in other places are found large quantities of pyrites of iron, in which there is a small quantity of the tungsten mineral. In the Animas vein the wolframite is found in the form of crystals incrusting the quartz. They are very fine and mixed with iron pyrites; it is rare to find the pure wolframite in this vein. The vein rock here is also ferruginous quartz, with considerable iron pyrites.

METALLIC TUNGSTEN AND TUNGSTEN ALLOYS.

The only form in which the metallic tungsten has been prepared for market is as the black powder obtained by the chemical reduction of

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[a] Guy de Ricketts, Mining Jour., London, England, Nov. 12, 1904.

[b] Bull. No. 11, Peruvian Min. Engineers, 1904, and Mining World, Dec., 1904.

the ores, and in this country this reduction is carried on principally by the Primos Chemical Company, of Primos, Pa. Often this metallic tungsten powder becomes somewhat oxidized, so that it is apt to contain some of the tungsten oxide. Fused metallic tungsten has not as yet been made commercially by any of the processes referred to, by which many of these steel-hardening metals have been obtained. Hence at the present time tungsten steel is manufactured either by the introduction of this powdered metallic tungsten or by the addition of the ferro-alloy.

The ferro-alloy can not be produced in the blast furnace on account of the high temperature required, and therefore the electric furnace has been used, in which the tungsten concentrates are reduced directly to the ferro-alloy. A ferrotungsten alloy has also been made by the Rossi method, the concentrates used having the following composition:

Constituent.	Per cent.
WO_3	69.86
SiO_2	5.4
FeO	20.25

A ferro-tungsten alloy was obtained that had the following composition:

Constituent.	Per cent.	Constituent.	Per cent.
W	75.91	S	0.08
Fe	21.47	C	.90
Si	1.61	Al	Nil.

In the production of these ferro-alloys by the Rossi method, if a lower percentage of tungsten is desired, it can be obtained by introducing with the concentrates scrap iron in the proper quantity to give the required percentage of tungsten in the alloy. A ferro-tungsten has also been made by the Wilson Aluminum Company in their electric furnace at Kanawha Falls, W. Va., by George G. Blackwell Sons & Co. (Limited), Liverpool, England, and by a number of French and German companies. The percentages of these ferro-tungsten alloys vary considerably, the tungsten content varying from 30 to 85 per cent. The composition of some of the ferro-tungstens on the market are shown in the following table of analyses, the first two being ferro-tungsten alloys manufactured by the Wilson Aluminum Company and the last three by George G. Blackwell Sons & Co.:

Analyses of ferro-tungstens.

Constituent.	1.	2.	3.	4.	5.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Tungsten	60.92	83.90	78.80	84.30	85.79
Iron	28.38	12.10	10.90	14.90	13.50
Chromium	2.36	....	....	.08	.12
Carbon	Undet.	3.30	3.20	.72	.60
Silicon	.56	.50	1.87	....	.06
Phosphorus	....	....	.10	.005	.003
Sulphur	....	....	.11	.03	.03

There is a difference of opinion as to the merits of the powdered metallic tungsten made by the chemical works and of the ferro-alloys made by the electric furnaces when used in the manufacture of tungsten steel. The Germans seem to prefer the powdered metallic tungsten, and this is also being used to a considerable extent in America. Others, as the English manufacturers, prefer the ferro-tungsten, and a number of reasons have been advanced why the ferro-tungsten is more satisfactory than the metallic powder. Mr. R. A. Hadfield, of Sheffield, England, believes that the former inability to produce tungsten steel of uniform quality was due partly to the fact that the supposed metallic tungsten used contained more or less oxide. It is also claimed by some that the ferro-tungsten alloy unites more readily with the steel and almost quantitatively without loss, and that the metallic powder oxidizes more easily and is more refractory; that the alloy is more apt to contain less impurities than the powder, and that the unit of tungsten in the ferro-alloy costs less than the unit of tungsten in the powder. If a fused metallic tungsten should be obtained which could be used in the manufacture of tungsten steel, it may be that it would have advantages over the ferro-tungsten and that some of the disadvantages alleged against the powder would not apply to the fused metal.

Besides the ferro-tungsten alloys, there are a number of alloys of tungsten with iron and nickel, with iron and chromium, and with nickel. There seems to be an increasing demand for the use of tungsten steel in the manufacture of high-speed tools and magnets, although some molybdenum steels have been utilized for these purposes. It is also used to some extent in the manufacture of armor plate and armor-piercing projectiles. It has also been claimed that tungsten steel has been employed in the manufacture of large guns; but thus far no tangible proof can be obtained that it has been used for this purpose. It would no doubt, however, add to the life of the guns, by increasing their strength and durability.

Tungsten steel would also be of value for structural iron work. It is, however, a question whether tungsten steel for this purpose could, at the present price of tungsten, compete with the nickel steel used for the same purposes.

The percentage of tungsten in these steels varies considerably, according to the purposes for which the steel is to be employed, this variation being from 3 to 10 per cent and occasionally to 24 per cent of tungsten and from 0.4 to 2 per cent of carbon. Moreover, some of the tungsten steels contain from 3 to 4 per cent of chromium, and others from 2 to 5 per cent of nickel.

MOLYBDENUM.

OCCURRENCES AND LOCALITIES.

The sources of supply of molybdenum are the two minerals molybdenite, the molybdenum sulphide (MoS_2), and wulfenite, the lead molybdate ($PbMoO_4$). The former mineral usually occurs in foliated masses or in scales with a perfect basal cleavage and metallic luster. It is very soft, being only 1 to 1.5 in hardness, and is readily scratched with the finger nail. It is of a pure lead-gray color and is often mistaken for graphite, which it sometimes very closely resembles, but can be distinguished by its color, which is of a very bluish gray; by its streak on paper, which is gray to bluish gray, while graphite is black; and by its behavior before the blowpipe, molybdenite giving off sulphur dioxide, which can be readily detected by its odor, while there is no change when the graphite is heated. It crystallizes in the hexagonal system; but well-developed crystals are rare, as they are usually rough and striated.

Some interesting results have recently been obtained by Mr. A. J. Moses regarding the crystallization of the mineral molybdenite. On account of the striations that constantly occur upon the pyramidal faces of this mineral, and the frequent bending of the crystals, as shown by grooves and ridges upon the cleavage surfaces, many accurate measurements have not been obtained upon the crystals. Mr. Moses has examined crystallographically molybdenite crystals from Enterprise, near Kingston, Ontario; Aldfield, Quebec; Cape Breton; Okanogan County, Wash.; the Tilley-Foster mine, Brewster, N. Y.; and from Warren, N. H. Summing up the results of his work, the crystallographic measurements obtained would be as follows, in which the pyramid *o*, makes an angle with a cleavage plane $c \wedge o = 65^\circ 35'$, from which the vertical axis $c' = 1.908$:

Basal pinacoid, *c* (0001).—Not observed, except possibly on Enterprise, Ontario, crystal.

Prism, *m* ($10\bar{1}0$).—Frankford, Pa., sometimes prominent; Aldfield, Quebec, as part of striations; Warren, N. H., traces.

Pyramid, *q* ($30\bar{3}1$).—Calculated angle, $81^\circ 24'$. Observed at Frankford, Pa. Measured angle, $81^\circ 31'$.

Pyramid, *p* ($20\bar{2}1$).—Calculated angle, 77° 13′. Measured angles:

	°	′
Frankford, Pa	77	15
Aldfield, Quebec	77	18
Cape Breton	77	29
Okanogan County, Wash	76	59

Pyramid, *r* ($50\bar{5}4$).—Calculated angle, 70° 03′. Observed at Narksak, Greenland. Measured angle, 70° 31½′.

Pyramid, *o* ($10\bar{1}0$).—Unit angle, Frankford, Pa., 65° 35′. Measured angles:

	°	′
Tilley-Foster mine, N. Y	65	29
Auerbach, Hesse	65	48
Warren, N. H	64	27

Pyramid, *t* ($20\bar{2}3$).—Calculated angle, 55° 45′. The Warren, N. H., angles for this, 54° 43′, and unit are *relatively* close for these indices but low for the brown unit.

Pyramid, *s* ($20\bar{2}5$).—Calculated angle, 41° 23′. Measured angles:

	°	′
Enterprise, Ontario	41	26
Okanogan County, Wash	41	46

Pyramid, *v* ($10\bar{1}4$).—Calculated angle, 28° 51′. On Okanogan County, Wash., crystal, the angle 29° 54′ was obtained, which was near these indices, for $20\bar{2}5$ = 41° 46′.

Molybdenite usually occurs embedded in or disseminated through crystalline rocks, principally in granite, gneiss, syenite, and granular limestone; but, judging from the descriptions of the occurrences of this mineral, it has been found in practically all of the main groups of rocks. A list of rocks containing molybdenite has been summarized by Mr. A. R. Crook,[a] to which a few additions have been made.

SUMMARY OF MOLYBDENITE OCCURRENCES.

1. Granite (Schlesien, Böhmen, Bayern, England, Norway, Ceylon, Tasmania, New South Wales, Victoria, and various parts of Canada and the United States).
2. Pegmatitic dikes (United States).
3. Gneiss (Baden, Mähren, France, Norway, Connecticut).
4. Syenite (Norway).
5. Mica-schist (Switzerland, Sweden).
6. Pyroxenite (Canada).
7. Basalt (Sardinia).
8. Gabbro (Harz).
9. Serpentine (Tyrol).
10. Amphibolite-schist (Finland).

[a] Bull. Geol. Soc. America, vol. 15, 1904, p. 284.

11. Chlorite-schist (Kärnten, Sweden, Finland).
12. Talc schist (Finland).
13. Garnetite (Hessen).
14. Contact of marble with pyroxenite (California).
15. Granular limestone (Hessen, Ungarn, United States).
16. Conglomerate (Switzerland).

Although the occurrences of molybdenite are so varied, there are but few of them that contain the mineral in any large quantity and at the present time most of the commercial supply of molybdenite is obtained from quartz veins in granitic rocks, from pegmatitic dikes cutting granitic rocks, or from impregnations in granitic rocks.

In the United States the two principal deposits of this mineral that have been thus far exploited are in the vicinity of Crown Point, Chelan County, Wash., and at Cooper, Washington County, Me. The former deposit has recently been described by Mr. A. R. Crook.[a]

The location of this deposit is in Chelan County, which is a little north of the center of the State of Washington, and about 30 miles from the head of Lake Chelan, which extends for about 60 miles in a narrow rock gorge from 2 to 4 miles in width. At the head of the valley the gorge extends westward from the lake to where rises a nearly precipitous granite cliff in which is the molybdenite deposit. The first tunnel was started 900 feet up the side of the cliff. The molybdenite occurs in a blanket quartz vein which outcrops along the perpendicular granite cliff referred to for a distance of several hundred feet. It is nearly horizontal, but in places has an inclination of from 5 to 6 degrees toward the west. The vein varies in thickness from 2 to 3 feet and has been opened by means of two tunnels, one extending 195 feet toward the northeast and the other 80 feet westerly. The molybdenite is found in the quartz in small seams up to several inches in thickness that appear to ramify through the quartz in all directions, and it has not thus far been found in the biotite granite which incloses the vein. The molybdenite occurs in flakes from minute particles to irregular masses, and also in crystals that, for molybdenite, are very well developed.

The Cooper, Me., molybdenite deposit has been described by Dr. George Otis Smith.[b] The deposit is in Washington County in the extreme southeastern part of Maine, and has been operated by the American Molybdenum Company. At this locality prospecting for molybdenite has been carried on at several points, but thus far the only important development is at the property of the above-named company. The occurrence of the molybdenite at this locality is in pegmatitic dikes, and also in the granite that is cut by these dikes.

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[a] Bull. Geol. Soc. America, vol. 15, 1904, p. 284.

[b] Bull. U. S. Geol. Survey No. 260, 1905, p. 197.

There are a number of these pegmatitic dikes on the property, and they vary in width from a few inches to several feet. As far as could be determined, the molybdenite is perhaps more abundant near the contact of the pegmatitic dikes with the country rock, although there is no parallel arrangement of the minerals. In the granite it occurs as disseminated flakes, which are most abundant near the contact of the granite with the pegmatitic dikes. In commenting on the origin of the molybdenite in this locality, Mr. Smith states that "the pegmatitic dikes are probably approximately contemporaneous with the granite intrusion, representing the latest crystallization of the granitic magma and therefore intruding the consolidated granite." In this pegmatite magma the molybdenum disulphide seems to have been a prominent constituent and to have crystallized out early in the consolidation of the dikes. Regarding the molybdenite in the granite Mr. Smith considers that it should be either the result of impregnation at the time of the pegmatitic intrusion, or an original constituent, the former view being supported by the apparently greater quantity of this mineral in the granite near the dikes.

Other localities in the United States where molybdenite has been found in some quantity are near East Las Vegas, San Miguel County, N. Mex., the property being controlled by Mr. Arthur N. Jordan, of Denver, Colo.; and in Beaverhead County, Mont., about 30 miles northwest of Dillon and 10 miles west of the Oregon Short Line Railroad, at an elevation of about 10,000 feet, a deposit of molybdenite has been developed by Messrs. L. D. Graeter and A. H. French, of Dillon, Mont. The molybdenite is found in two prominent seams or veins of quartz, averaging about 10 inches in thickness, which outcrop for a distance of 300 feet. The strike of one of these seams is nearly east and west and the other northeast-southwest. The country rock, which is granitic in character, between these two veins, contains streaks of molybdenite and also a number of seams of quartz cutting through it, which also contain particles of molybdenite. Molybdenite has also been found about 2 miles east of Ophir, Mont., in a carboniferous gulch, and has been developed to a slight extent by Mr. T. L. Quigley, of Ophir, Mont.

Localities which contain deposits of wulfenite in any large quantity are not common, and the only ones known at the present time in this country are in Pinal County, Ariz. The mineral has been found in connection with gold or copper mining. The first mining for wulfenite was at the Mammoth mine in the southeastern portion of Pinal County, on the Rio San Pedro. This is one of the famous gold mines of Arizona, and a considerable quantity of wulfenite was accumulated in the large dumps of tailings at the mine. These have been worked up during the last three years and have furnished all of the wulfenite that has been thus far produced for market in this country. There was a similar occurrence of wulfenite discovered at Troy, in the eastern part of Pinal County, within a few miles of the Gila County line, in a mine that has been opened for copper. The wulfenite occurs in veins of quartz and averages about 1½ to 3 per cent of the material mined. A concentrating mill has been erected for separating the wulfenite from its gangue, and the Troy-Manhattan Copper Company, which owns the property, is installing a plant for treating the wulfenite concentrates.

Deposits of molybdenite have been found at various localities in New Brunswick, Ontario, Quebec, and in British Columbia, and deposits are also known to exist in Norway, France, Queensland, Australia, Scandinavia, and Japan.

METALLIC MOLYBDENUM AND MOLYBDENUM ALLOYS.

Metallic molybdenum has been prepared by the alumino-thermit process and is obtained as a metal of a steel-gray color like steel, having a dense structure. Its chief impurity is from 1 to 2 per cent of iron, besides very small quantities of silicon, thus making its purity from 98 to 99 per cent. This metallic molybdenum is free from carbon. It has also been made by George G. Blackwell Sons & Co., of Liverpool, England, whose product contains from 95 to 98 per cent of molybdenum and only a trace of carbon. The metal is also obtained in the chemical manufacturing plants as a powder, but there seems to be some tendency for it to oxidize.

The ferro and other molybdenum alloys are also made quite extensively by a number of companies, including the Th. Goldschmidt Company, of Essen-Ruhr, Germany, by the alumino-thermit process; the Néo-Métallurgie Société at Rochefort sur Mayenne, France; George G. Blackwell Sons & Co. (Limited), of Liverpool, England, and others. There are a number of ferro-molybdenum alloys on the market which vary in their percentage of molybdenum from 60 to 80 per cent, and from 0 to 2 or 3 per cent of carbon, according to the process by which they are made. Some of the ferro-alloys made by George G. Blackwell Sons & Co. of Liverpool, England, run about 80 to 85 per cent metallic molybdenum, with about 2 to 3 per cent of carbon. They also make ferro-molybdenum alloy with 85 per cent of molybdenum and only about 0.25 per cent of carbon. There are a number of other molybdenum alloys besides these ferro-alloys, principally those containing nickel. Two of these molybdenum-nickel alloys are produced, one of which contains 75 per cent molybdenum and 25 per cent nickel, and the other about 50 per cent molybdenum and 50 per cent nickel. These percentages vary slightly according to impurities that may be in the alloys, as, for example, from 2 to 2.5 per cent iron, 1 to 1.5 per cent carbon, and 0.25 to 0.50 per cent silicon. Another alloy is a molybdenum-chromium alloy containing 50 per cent of chromium and 50 per cent of molybdenum, with no carbon, this alloy being made by the Th. Goldschmidt Company. These alloys of molybdenum and nickel and of molybdenum and chromium have been prepared for the market on account of the demand arising for them in the manufacture of specially hardened steel, as better results can apparently be obtained with the molybdenum when it is used in conjunction with either nickel or chromium.

Molybdenum increases the elongation of steel very considerably, and for wire drawing such an increase at a comparatively small cost is important. It also renders tool steel especially hard and capable of retaining a cutting edge. It is beginning to be used quite extensively for tool steel in place of tungsten, which was one of the first metals thus used. It requires a smaller percentage of molybdenum to give the required results, and, as far as can be ascertained, it is easier to harden molybdenum steel than tungsten steel. Some of the uses made of molybdenum steel are in the manufacture of large cranks and propeller-shaft forgings, for large guns and rifle barrels, for wiring, for boiler plates, and for tools.

VANADIUM AND URANIUM.

OCCURRENCES.

A portion of the supply of these two metals is obtained from carnotite ores found in Montrose County, Colo., and the adjoining Grand County, Utah. The deposits in Montrose County, Colo., have been previously described,[a] and the Utah deposits have recently been described by Mr. J. M. Boutwell.[b] The deposits occur in the extreme eastern and southeastern portions of Utah, in the margins of the basin of the Green, Grand, and Colorado rivers, and they are in the same general geographic provinces as the deposits of the adjoining western Colorado, probably in an equivalent series of rock formations. The deposits do differ, however, in their mineralogical characteristics and in certain features of geological occurrence. The principal deposit of Utah is near Richardson, Grand County, in the canyon of the Grand River, 27 miles down the canyon from Cisco, a station on the Rio Grande Western Railway. The vanadium ores consist of compounds of vanadio-arsenates of copper, barium, and calcium. These, with perhaps other compounds of vanadium, occur in aggregates of small, brittle, green, greenish-yellow, and yellowish-green crystals. Their exact mineralogical character has not as yet been definitely determined. The vanadium ores associated with carnotite, the principal uranium ore of Colorado, are found in much less quantity than the vanadium

[a] Mineral Resources U. S. for 1899 and 1900, U. S. Geol. Survey, and Am. Jour. Sci., 4th series, vol. 10, 1900, pp. 120–144.
[b] Bull. U. S. Geol. Survey No. 260, 1905, pp. 200–210.

ores alone. The vanadium minerals and the carnotite occur in thin patches and as coatings on the walls or cracks in a fractured zone in sandstone. This fractured zone is 5 to 25 feet in width and is the main line of deformation in that region; its strike is N. 60° E., and it dips to the southeast at an angle of 70°. The deposits near Richardson have been developed by the Welsh-Lofftus Uranium and Rare Metals Company. Another deposit[a] that has been worked to some extent is about 15 miles southwest of Grand River station, on the Rio Grande Western Railway, on the western margin of the Grand River basin, near San Rafael River. This deposit is composed of carnotite and occurs in sandstone or conglomerate. There are a number of other localities in the southeastern part of Utah, one being in Wild Horse Canyon, 8 to 10 miles north of Hanksville, Wayne County; one north of Price, Carbon County; another in the Abajo Mountains, San Juan County, and another south of Thompsons, Grand County. None of these, however, have been prospected to any extent, and little or nothing is known regarding them.

Besides carnotite, which is the source of both uranium and vanadium, the other chief source of supply of uranium is the mineral uraninite, or pitchblende, which has been found most extensively in Gilpin County, Colo. The main producer of uraninite has been the Wood mine, in Russell mining district. It is also found in some quantity at the Black Hawk and the Kirk mines, also near Central City, Gilpin County.

Minerals containing these metals are found in much smaller quantity in many places throughout the United States, but none of them have thus far developed into commercial sources of supply.

In the western part of North Carolina, at the Flat Rock mica mine, near Spruce Pine, Mitchell County, the mineral uraninite has been found in some quantity. It does not occur in sufficient amount to warrant mining for this mineral alone. If, however, this property were reopened as a source of mica, there would be more or less of the uraninite obtained as a by-product.

A vanadium deposit has recently been described in Mexico by Prof. Gustavo De J. Caballero.[b] The vanadium minerals are found at Charcas, State of San Luis Potosi, and they are being systematically mined and are exported, principally to France. The principal vanadium mineral at this locality has been described as a new vanadium mineral named ramirite. This has been analyzed by Señor Caballero with the following results:

[a] Bull. U. S. Geol. Survey No. 260, 1905, pp. 200-210.

[b] Bull. No. 10, Mex. Geol. Inst., Memorias de la Sociedad Cientifica, 1904.

Analysis of ramirite from Charcas, Mexico.

Constituent.	Percentage.	Constituent.	Percentage.
V_2O_5	23.68	P_2O_5	4.57
PbO	58.29	As_2O_5	7.90
ZnO	5.32	H_2O	1.12
CuO	5.18	Total	106.20
Mn_2O_3	.14		

METALLIC URANIUM AND VANADIUM AND THEIR FERRO-ALLOYS.

Of these two metals, uranium and vanadium, it is only the latter that has been used in the manufacture of steel, although uranium has been tested and experimented with to some slight extent for this purpose. It is claimed that the vanadium increases the tensile strength and toughness of the steel, but there is still considerable controversy regarding the influence of vanadium on iron and steel products, and it can not yet be definitely stated what place vanadium steel will take in the steel-manufacturing world. No large quantity of vanadium steel has been made, and there is but very little of it on the market, although the ferro-alloys are now being made and offered for sale. A ferro-vanadium alloy free from carbon and containing 25 per cent of vanadium has been made by the Th. Goldschmidt Company. A ferro-silicon vanadium alloy is also reported as having been prepared, which contains 30 per cent of vanadium, 10 per cent of silicon, and 2 per cent of carbon. George G. Blackwell Sons & Co. (Limited) report a ferro-vanadium alloy containing from 45 to 55 per cent of vanadium.

An electrolytic method for the production of ferro-vanadium has been described by Gustave Gin,[a] the French electro-metallurgist, which depends upon the electrolysis of vanadium fluoride dissolved in calcium fluoride. A bath of liquid iron is the cathode and a specially prepared and compressed mixture of vanadium trioxide and carbon is the anode. The fluorine, which is produced by the electrolysis of the vanadium fluorine, attacks and dissolves the vanadium compound of the anode, which thus regenerates the electrolyte, while free vanadium produces alloys with the iron.

A recent invention of Wilhelm von Siemens is the use of metallic vanadium in the manufacture of a glow lamp.

The metal uranium is included with the steel-hardening metals on account of the experiments that have been made with it for this purpose, on account also of its close relation to vanadium, and because so many of the ores of vanadium contain uranium.

All of the uranium minerals have become of special interest in the last year or two since the discovery of radium, as uranium seems to be

[a] Electro-chem. Ind., vol. 2, 1904, p. 321.

the source of radium. In a recent article on the origin of radium[a] Mr. B. B. Boltwood, of New Haven, Conn., has given data which seem to show that uranium is the source of radium and also that there is a constant proportionality between the uranium and the radium in the various minerals containing these elements. A long series of minerals have been analyzed by Mr. Boltwood for their uranium and radium contents. It is interesting to note that the uraninite from the Flat Rock mine, North Carolina, showed the highest radio-activity of any of the minerals examined. In the following table are given the mineral substances tested, their locality, their uranium content, and the activity of the emanation contained in one gram of the mineral:

List of uranium minerals examined for radio-activity.

Substance.	Locality.	Per cent of uranium.	Activity of emanation.
Uraninite	North Carolina	74.65	150.7
Do	Colorado	69.61	147.1
Gummite	North Carolina	65.38	126.7
Uraninite	Joachimsthal	61.74	131.8
Uranophane	North Carolina	51.68	108.0
Uraninite	Saxony	50.64	112.5
Uranophane	North Carolina	49.84	88.8
Thorogummite	do	33.17	61.1
Carnotite	Colorado	22.61	41.6
Uranothorite	Norway	11.38	24.9
Samarskite	North Carolina	10.44	23.2
Orangite	Norway	10.34	22.84
Euxenite	do	8.71	19.8
Thorite	do	7.54	15.6
Fergusonite	do	5.57	11.95
Æschynite	do	4.52	9.98
Xenotime	do	.70	1.14
Monazite	North Carolina	.43	.88
Do	Norway	.41	.84
Do	Brazil	.31	.76
Do	Connecticut	.30	.63
Allanite	North Carolina	.007	.014

TITANIUM.

TITANIUM ALLOYS.

Although the actual commercial value of titanium as a steel and iron hardening metal has not as yet been thoroughly demonstrated, still the experimental work that has been done seems to indicate that titanium will become of some importance in the production of both coke and charcoal iron. The exhaustive experiments that have been made by Mr. A. J. Rossi in regard to titanium show that the introduction of a very small percentage (0.5 to 2 per cent) will increase the tensile

[a] Philos. Mag., April, 1905, p. 599.

strength of both coke and charcoal iron. In introducing titanium into these irons use is made of a ferro-titanium alloy containing from 10 to 12 per cent titanium, which is added to the furnace. With the cupola the best results are obtained by adding the alloy in small pieces, which, of course, necessitates a previous crushing. This, however, could be avoided where foundries are of small size by casting the alloy in the form of pigs and adding the latter directly to the furnace charged, as is done with ordinary cast iron, experiments having shown that a titanic pig containing up to 5 per cent titanium will melt at the temperature of fusion of cast iron or steel. A series of experiments have been described by Mr. Rossi that were made with both coke and charcoal iron, and also with coke iron and charcoal iron containing 2 per cent of titanium. In describing these tests Mr. Rossi says:[a]

The materials used in these tests were made by adding the alloy in either the cupola or the ladle, the results being nearly the same in each case. The cupola—2,000 pounds capacity—was first charged with pig iron and coke, without any addition whatever, and a part of the molten iron was cast in pigs and round bars (18 inches long by 1.125 inches in diameter), or in square bars (13 inches long by 1 inch square), while another portion was poured into 300-pound ladles into which certain quantities of alloys (10 to 12 per cent Ti) were added at the bottom. After dropping, the cupola was again charged with pig iron and coke by layers as usual, with the addition in each layer of a part of the total quantity of alloy that was to be used in the charge. The alloy was added in lumps from 1 to 2 inches in size. For each mixture the cupola was charged with fresh material. The pig iron used was of two grades—No. 2 foundry coke (Warwick brand) and No. 1 best charcoal pig (Muirkirk brand). The tests were made at the laboratories of Finius, Olsen & Co., of Philadelphia. With due corrections for area, the results were as follows:

Strength tests of titanium iron.

	No. 2 coke iron (Warwick).		No. 1 charcoal iron (Muirkirk).	
	Pig smelted alone.	Pig smelted with 2 per cent of alloy.	Pig smelted alone.	Pig smelted with 2 per cent of alloy.
	Pounds per square inch.	*Pounds per square inch.*	*Pounds per square inch.*	*Pounds per square inch.*
Tensile strength	24,840	27,800	28,430	31,680
	25,450	28,850	27,950	30,400
	24,600	27,600	27,500	31,230
Tensile strength (average)	24,960	28,125	27,960	30,800
Transverse strength			2,930	3,112
			2,873	3,250
			2,993	3,215
Deflection at center of bar (12 inches between bearings)			0.14	1.155

As is seen from this table, the average tensile strength of the coke iron containing the titanium is little greater than the average tensile strength of the charcoal iron, and it could undoubtedly be made at a cost considerably lower than that of the charcoal iron.

[a] Min. Industry, vol. 11, 1902, p. 694.

Other uses for these ferro-titanium alloys are in the manufacture of iron for car wheels, and perhaps also for rolls and crushers. At the present time the principal uses of titanium are not in the manufacture of titanium steel, but in the form of the oxide for use in the manufacture of artificial teeth and for coloring.

A ferro-titanium free from carbon and containing 20 to 25 per cent of titanium is now being manufactured by Th. Goldschmidt. Another ferro-titanium alloy containing 45 to 55 per cent titanium is manufactured by George G. Blackwell Sons & Co. (Limited).

SOURCES OF SUPPLY.

The common mineral which is mined for its titanium contents is rutile, and in the United States the principal locality where this mineral is found is in Virginia, at Roseland, Nelson County, where are located the works of the American Rutile Company. The mineral occurs disseminated through a coarsely crystalline granitic rock which has been mined by means of open cuts. This rock is crushed and the rutile is easily concentrated. The demand for the mineral is limited. Another source of supply of titanium, if the use of the ferroalloys increases so that there will be a demand for them on a large scale, would be undoubtedly the titanic iron ores which occur in considerable quantity in various parts of the United States.

MANGANESE.

Although the production of manganese is not regularly treated in this report, it may be of interest to introduce here a few words regarding the manufacture of metallic manganese and of the ferro-manganese alloys. This metal has been prepared by the alumino-thermit process by Th. Goldschmidt, Essen-Ruhr, Germany, free from carbon and containing from 98 to 99 per cent manganese, and with only a trace of iron. The ferro alloy of manganese was one of the first alloys to be made in the electric furnace, but, as far as can be learned, the manufacture of the ferro-manganese alloy in the electric furnace is attained with considerable difficulty, due principally to the absolute necessity of avoiding too high a temperature, which would cause a volatilization of the manganese, and, therefore, it is still the blast furnace in which most of the ferro-manganese is produced.

TOTAL PRODUCTION OF STEEL-HARDENING METALS.

The total production of steel-hardening metal ores or concentrates produced in 1904 amounted to 945 short tons, valued at $259,620, including production of rutile valued at $7,000. Over three-fourths of this quantity was due to tungsten ores. The States producing these ores, in the order of the value of their production, together with the metallic ore mined, are Colorado (tungsten, uranium, and vanadium), Arizona (tungsten and molybdenum), California (chromium), Washington (molybdenum), Missouri (nickel and cobalt), and Virginia (titanium).

In the following table is given the production in the United States of ores of the steel-hardening metals for the years 1902, 1903, and 1904:

Production of ores of steel-hardening metals in the United States, 1902–1904, by metals.

[Short tons.]

Mineral.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Chromium	353.0	$4,567	168	$2,250	138.0	$1,845
Molybdenum			795	60,865	14.5	2,175
Nickel and cobalt	[a] 20.0	9,415	[b] 661	273,900	[c] 23.0	54,000
Titanium						7,000
Tungsten	183.5		292	43,639	740.0	184,000
Uranium and vanadium	3,810.0	48,125	30	5,625	44.5	10,600
Total	4,328.5	62,109	1,928	386,279	945.0	259,620

[a] Matte.
[b] Nickel and cobalt oxide contents of 3,600 tons of low-grade matte, not refined in 1904.
[c] Combined metals.

PRODUCTION OF NICKEL AND COBALT IN UNITED STATES.

The main supply of nickel and cobalt produced in the United States in the last few years has been obtained from Mine La Motte, Mo., as a by-product in lead smelting. During 1904, however, there was no actual production of any metallic nickel or cobalt oxide, but there was obtained 3,600 short tons of low-grade material, valued at $54,000, that is ready to be smelted and refined. This contains approximately 24,000 pounds of metallic nickel, valued at $11,400, and 22,000 pounds of cobalt oxide, valued at $42,600. In 1903 there was a production reported of 661 tons of matte, of which the nickel content amounted to 114,200 pounds, valued at $45,900, and the cobalt oxide content to 120,000 pounds, valued at $228,000. There was also produced in 1903 nickel and cobalt ores amounting to 135 tons in Oregon and Idaho, of which 21 tons, valued at $1,900, were shipped. There was no ore produced at either of these localities in 1904, but in Virginia and North Carolina there was a considerable tonnage of low-grade ore produced in development work at deposits located at Hemlock, Floyd County, Va., and near Webster, Jackson County, N. C. None of this, however, was shipped during the year.

In the following table is shown the production and value of nickel obtained from domestic ores from 1887 to 1904, inclusive:

Production of nickel from domestic ores in the United States, 1887–1904.

[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	1904	24,000	11,400

In the next table is given the quantity of cobalt oxide obtained from domestic ores mined in the United States from 1869 to 1904, inclusive:

Production of cobalt oxide in the United States, 1869–1904.

[Pounds.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1869	811	1881	8,280	1893	8,422
1870	3,854	1882	11,653	1894	6,763
1871	5,086	1883	1,096	1895	14,458
1872	5,749	1884	2,000	1896	10,700
1873	5,128	1885	8,423	1897	19,520
1874	4,145	1886	8,689	1898	6,247
1875	3,441	1887	[a] 18,340	1899	10,230
1876	5,162	1888	8,491	1900	6,471
1877	7,328	1889	13,955	1901	13,360
1878	4,508	1890	6,788	1902	3,730
1879	4,376	1891	7,200	1903	120,000
1880	7,251	1892	7,869	1904	22,000

[a] Including cobalt oxide in ore and matte.

CANADIAN PRODUCTION OF NICKEL.

Nearly all of the nickel used in the United States is obtained from Canada, with a small quantity from New Caledonia. For this reason the production of nickel ore in Canada is of especial interest to the users of the metal in the United States, and there is, therefore, given in the table following the quantity of nickel ore mined and smelted in Canada, together with the quantity of matte obtained from it for the years 1896 to 1904, inclusive:

Production of nickel in Canada, 1896–1904.[a]

Year.	Ore produced.	Ore smelted.	Matte obtained.	Nickel in matte.
	Long tons.	*Long tons.*	*Long tons.*	*Pounds.*
1896	109,097	73,505	9,733	3,897,000
1897	93,155	96,093	14,034	3,998,000
1898	123,920	121,924	21,101	5,567,000
1899	203,118	171,230	19,215	5,744,000
1900	216,695	211,960	23,448	7,080,000
1901	326,945	270,380	45,134	8,882,000
1902	269,538	233,338	24,691	10,693,410
1903	136,633	209,030	13,832	12,505,510
1904	203,388	118,470	8,924	10,548,000

[a] As reported by the director of the bureau of mines, Ontario, Canada.

As is seen from this table, there has been a steady increase in the actual production of nickel, which is represented by nickel in matte, from 1896 to 1903, but in 1904 there was a falling off in the production of nickel of approximately 2,000,000 pounds as compared with the nickel content of the matte in 1903. One interesting point brought out by the table is the better quality of matte, containing a much higher percentage of nickel, that has been obtained during the last few years.

During 1904 there was exported from Canada 10,154 short tons of matte, which is 1,230 short tons more than was produced in 1904, this excess representing stock left over from 1903. Of this matte shipped the larger part went to the United States and represents an exportation to this country of 9,204,961 pounds. The remainder of the matte, which represents 2,028,908 pounds of nickel, was shipped to Great Britain.

IMPORTS OF NICKEL AND COBALT.

There was quite a falling off in the importation of nickel compounds and matte, etc., during 1904, the quantity imported into the United States in 1904 being 19,739,315 pounds, valued at $1,121,491. As compared with the importation of 1903 of 36,217,985 pounds, valued at $1,493,889, it is a decrease of 16,478,670 pounds in quantity, but of only $371,398 in value. This very large decrease in quantity with only a comparatively small increase in value is due to the higher grade matte that is imported.

The importation of cobalt oxide in 1904 amounted to 42,354 pounds, valued at $86,925. Besides this cobalt oxide there were imported 330,983 pounds of cobalt ore and metallic cobalt, valued at $18,272, making the total value of the importation $105,197. In the tables which follow are given the importation of cobalt oxide and nickel products into the United States from 1868 to 1904, inclusive.

Cobalt oxide imported and entered for consumption in the United States, 1868–1904.

[Pounds.]

Year ending—	Oxide.		Year ending—	Oxide.	
	Quantity.	Value.		Quantity.	Value.
June 30—			December 31—		
1868		$7,208	1886	19,366	$29,543
1869		2,330	1887	26,882	39,396
1870		5,019	1888	27,446	46,211
1871		2,766	1889	41,455	82,332
1872		4,920	1890	33,338	63,202
1873	1,480	4,714	1891	23,643	43,188
1874	1,404	5,500	1892	32,833	60,067
1875	678	2,604	1893	28,884	42,694
1876	4,440	11,180	1894	24,020	29,857
1877	19,752	11,056	1895	36,155	39,839
1878	2,860	8,693	1896	27,180	36,212
1879	7,531	15,208	1897	24,771	34,773
1880	9,819	18,457	1898	33,731	49,245
1881	21,844	13,837	1899	46,791	68,847
1882	17,758	12,764	1900	54,073	88,651
1883	13,067	22,323	1901	71,969	134,208
1884	25,963	43,611	1902	79,984	151,115
1885	16,162	28,138	1903	73,350	145,264
			1904	42,354	86,925

Nickel imported and entered for consumption in the United States, 1868–1904.

[Pounds.]

Year ending—	Nickel.		Nickel oxide, alloy of nickel with copper, and nickel matte.		Total value.
	Quantity.	Value.	Quantity.	Value.	
June 30—					
1868		$118,058			$118,058
1869		134,327			134,327
1870		99,111			99,111
1871	17,701	48,133	4,438	$3,911	52,044
1872	26,140	27,144			27,144
1873	2,842	4,717			4,717
1874	3,172	5,883			5,883
1875	1,255	3,157	12	36	3,193
1876			156	10	10
1877	5,978	9,522	716	824	10,346
1878	7,486	8,837	8,518	7,847	16,684
1879	10,496	7,829	8,314	5,570	13,399
1880	38,276	25,758	61,869	40,311	66,069
1881	17,933	14,503	135,744	107,627	122,130
1882	22,906	17,924	177,822	125,736	143,660
1883	19,015	13,098	161,159	119,386	132,484
1884			[a] 194,711	129,733	129,733
1885			105,603	64,166	64,166

[a] Including metallic nickel.

Nickel imported and entered for consumption in the United States, 1868–1904—Continued.

Year ending—	Nickel.		Nickel oxide, alloy of nickel with copper, and nickel matte.		Total value.
	Quantity.	Value.	Quantity.	Value.	
December 31—					
1886			277,112	$141,546	[a] $141,546
1887			439,037	205,232	[b] 205,232
1888			316,895	138,290	[c] 138,290
1889			367,288	156,331	[d] 156,331
1890	[e] 566,571	$260,665	247,299	115,614	376,279
1891	355,455	172,476	[f] 10,245,200	148,687	321,163
1892			[g] 4,487,890	428,062	428,062
1893			[g] 12,427,986	386,740	386,740
1894			[g] 9,286,733	310,581	310,581
1895			[g] 20,355,749	629,910	629,910
1896			[g] 23,718,411	620,425	620,425
1897			[g] 27,821,232	781,483	781,483
1898			[g] 60,090,240	1,534,262	1,534,262
1899			[g] 44,479,841	1,216,253	1,216,253
1900			[h] 57,500,800	1,183,884	1,183,884
1901			[i] 117,364,337	[i] 1,849,620	1,849,620
1902			[j] 33,942,710	[j] 1,437,649	1,437,649
1903			[k] 36,217,985	[k] 1,493,889	1,493,889
1904			[l] 19,739,315	[l] 1,121,491	[l] 1,121,491

[a] Including $465 worth of manufactured nickel.
[b] Including $879 worth of manufactured nickel.
[c] Including $2,281 worth of manufactured nickel.
[d] Including $131 worth of manufactured nickel.
[e] Classified as nickel, nickel oxide, alloy of any kind in which nickel is the element or material of chief value.
[f] Classified as nickel and nickel matte.
[g] Includes all nickel imports except manufactures; nearly all of this is nickel in matte from Canada, containing about 20 per cent nickel.
[h] Ore and matte. In addition 455,188 pounds of nickel, nickel oxide, etc., were imported, valued at $139,786.
[i] Including $209,956, the value of imports of 635,697 pounds of nickel, nickel oxide, alloy, etc., and $2,498 the value of imported manufactures of nickel not specially provided for.
[j] Besides nickel ore and nickel matte, these figures include 752,630 pounds, valued at $251,149, of nickel, nickel oxide, and alloys in which nickel is the chief constituent of value, and $30,128, the value of manufactures of nickel not specially provided for.
[k] 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.
[l] Besides nickel ore and nickel matte, these figures include 589,555 pounds, valued at $203,071, of nickel, nickel oxide, alloy in which nickel is the material of chief value, and $2,950, the value of manufactures of nickel not specially provided for.

EXPORTS OF NICKEL.

As would naturally be expected, considering that a very large part of the Canadian production of nickel matte is consumed in this country, there is exported each year from the United States a considerable quantity of nickel, and in 1904 this amounted to 7,519,206 pounds, valued at $2,130,933. The quantity and value of the nickel exported from the United States since 1894 are given in the table which follows:

Exports of nickel oxide and matte from the United States, 1894–1904.

[Pounds.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1894 [a]	1,235,588	$247,568	1900	5,869,906	$1,382,727
1895	1,061,285	239,897	1901	5,869,655	1,521,291
1896	2,756,604	600,833	1902	3,228,607	924,579
1897	4,255,558	997,391	1903	2,414,499	703,550
1898	5,657,620	1,359,609	1904	7,519,206	2,130,933
1899	5,004,377	1,151,454			

[a] Latter six months; not separately classified prior to July 1, 1894.

FOREIGN PRODUCTION OF NICKEL.

The bulk of the nickel ores produced in the world are obtained from Canada and from sources controlled by France and Germany. The French production is from the New Caledonia mines, and the German from the New Caledonia and the Norwegian mines. There is given in the following table the production of nickel in these countries from 1889 to 1904, as far as statistics can be obtained. 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 that is given in the table below:

Production of nickel in Canada, France, and Germany, 1889–1904.

Year.	Canada.		France.		Germany.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Metric tons.*		*Metric tons.*	
1889	830,477	$498,286	330	$324,900	282	$279,680
1890	1,435,742	933,232	330	317,300	434	436,430
1891	4,626,627	2,775,976	330	319,200	594	644,480
1892	2,413,717	1,399,956	1,244	1,174,580	747	698,630
1893	3,992,982	2,076,351	2,045	1,175,720	893	774,630
1894	4,907,430	2,061,120	1,545	1,175,720	522	449,350
1895	3,888,525	1,360,984	1,545	1,033,220	698	575,890
1896	3,397,113	1,188,990	1,545	875,330	822	666,900
1897	3,997,746	1,399,137	1,245	704,425	898	710,980
1898	5,517,690	1,820,838	1,540	887,800	1,108	670,482
1899	5,744,000	2,067,840	1,740	1,003,600	1,115	669,517
1900	7,080,000	3,327,707	1,700	1,020,000	1,376	946,884
1901	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	1,500	1,023,750	1,600	....
1904	10,547,883	4,219,153	....	....	....	....

PRODUCTION OF CHROMIUM.

California is still the only State producing any chromite, and in 1904 the quantity was 123 long tons of ore, valued at $1,845. As compared with the production of 150 long tons, valued at $2,250, in 1903, this is a decrease of 27 tons in quantity and of $405 in value. There is given in the following table the production of chromite in the United States since 1885:

Production of chromite, 1885–1904.

[Long tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
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	1904	123	1,845

IMPORTS OF CHROMIUM.

Practically all of the chromite consumed in the United States is imported, the greater quantity being obtained 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. The importation of chromate and bichromate of potash in 1904 was only 26,053 pounds, valued at $1,817, as compared with 41,229 pounds, valued at $2,784, the imports of 1903. There was, however, a considerable increase in the importation of chromic acid, the imports for 1904 amounting to 87,721 pounds, valued at $10,505, as against 57,799 pounds, valued at $5,465, in 1903. Besides this, chrome yellow was imported to the amount of 121,503 pounds, valued at $18,066, in 1904, as against 227,215 pounds, valued at $32,175, in 1903. Besides these chrome salts 24,227 long tons of chrome ore, valued at $348,527, were imported. This makes the total value of the chromium imports equal to $378,915, which is $36,466 greater than $342,449, the value of the imports for 1903. In the table which follows are shown the quantity and value of the chrome ore and chromium products imported 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, 1867–1904.

Year ending—	Chromate and bichromate of potash.		Chromic acid.		Chrome ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
June 30—	*Pounds.*		*Pounds.*		*Long tons.*		
1867	875,205	$88,787					$88,787
1868	777,855	68,634					68,634
1869	877,432	78,288		$3			78,291
1870	1,235,946	127,333		8			127,341
1871	2,170,473	223,529		5			223,534
1872	1,174,274	220,111	514	49			220,160
1873	1,121,357	178,472	922	276			178,748
1874	1,387,051	218,517	44	13			218,530
1875	1,417,812	183,424	45	22			183,446
1876	1,665,011	175,795	120	45			175,840
1877	2,471,669	264,392	13	10			264,402
1878	1,929,670	211,136	32	35			211,171
1879	2,624,403	221,151					221,151
1880	3,505,740	350,279	5	3			350,282
1881	4,404,237	402,088	124	89			402,177
1882	2,449,875	261,006	52	42			261,048
1883	1,990,140	208,681	290	338			209,019
1884	2,593,115	210,677		120	2,677	$73,586	284,383
1885	1,448,539	92,556		39	12	239	92,834
December 31—							
1886	1,985,809	139,117		101	3,356	43,721	182,939
1887	1,722,465	120,305		5,571	1,404	20,812	146,688
1888	1,755,489	143 312		281	4,410	46,735	190,328
1889	1,580,385	137,263		2,974	5,474	50,782	191,019
1890	1,304,185	113,613		634	4,353	57,111	171,358
1891	755,254	55,897	634	203	4,459	108,764	164,864
1892	496,972	94,055	772	204	4,930	55,579	149,838
1893	976,706	78,981	3,708	641	6,354	58,629	138,251
1894	1,483,762	125,796	5,680	837	3,470	38,364	164,997
1895	2,045,910	181,242	2,083	414	5,230	82,845	264,501
1896	952,794	80,538	2,429	387	8,669	187,400	268,325
1897	1,329,473	108,497	71,220	5,457	11,570	187,439	301,393
1898	1,160,710	86,134	5,329	1,758	16,304	272,234	360,126
1899	1,130,965	73,510	33,134	6,360	15,793	284,825	364,695
1900	111,761	7,758	35,452	7,232	17,542	305,001	319,991
1901	430,996	29,224	53,462	10,861	20,112	363,108	403,193
1902			90,817	11,115	39,570	582,597	593,712
1903	41,229	2,784	[a] 285,014	37,640	22,932	302,025	342,449
1904	26,053	1,817	[b] 209,224	28,571	24,227	348,527	378,915

[a] Includes 227,215 pounds of chrome yellow, etc., valued at $32,175.
[b] Includes 121,503 pounds of chrome yellow, valued at $18,066.

CANADIAN PRODUCTION OF CHROMIUM.

The Canadian deposits of chromite are located in the Province of Quebec and Newfoundland, and in 1904 the total production of Canadian chrome ore amounted to 6,074 short tons, valued at $67,146, an increase of 2,691 tons in quantity and of $33,316 in value, as compared with 3,383 tons, valued at $33,830, in 1903. Nearly all of the chromite produced was shipped to the United States. In the table following is given the production of Canadian chromite for the last three years:

Production of chromite in Canada, 1902–1904.

[Short tons.]

Year.	Quantity.	Value.
1902	900	$13,000
1903	3,383	33,830
1904	6,074	67,146

As is seen from this table there has been a decided increase in the production of chromite since 1902, when the Quebec deposits began to be quite extensively worked.

PRODUCTION OF TUNGSTEN.

There were produced in 1904 740 short tons of tungsten concentrates, valued at $184,000, as compared with 292 short tons of concentrates, valued at $43,639, in 1903, an increase of 448 tons in quantity and of $140,361 in value. The 1904 production of 740 tons of concentrates was obtained from 10,975 tons of crude ore.

IMPORTS OF TUNGSTEN.

During the last few years there have been small quantities of tungsten ores and alloys imported into the United States, but as the tungsten ores are admitted free of duty it has been impossible to obtain the statistics for them. In 1904 the imports of a ferro-tungsten-chromium alloy amounted to $29,439 in value, as compared with $18,136 in 1903 and with $7,046 in 1902.

PRODUCTION OF MOLYBDENUM.

The production of molybdenum ores in the United States is still very small, and in 1904 there were reported only 14½ short tons, valued at $2,175. There is still considerable uncertainty among producers of molybdenum ores as to the value of these ores, and prices are quoted as ranging from $100 to $3,000 per short ton. The actual value, however, of molybdenum concentrates at New York is probably about $200 to $250 per short ton.

PRODUCTION OF URANIUM AND VANADIUM.

Although there was considerable development work done in 1903 and 1904 upon uranium and vanadium deposits, the actual production of ores of these metals was very small, amounting in 1904 to 44½ short tons of concentrates and partially concentrated ore, valued at $10,600.

IMPORTS OF URANIUM.

The imports of uranium salts in 1904 were valued at only $9,024 as compared with imports valued at $13,498 in 1903 and at $12,491 in 1902.

PRODUCTION OF TITANIUM.

The production of rutile reported during the year 1904 was valued at approximately $7,000.

PLATINUM.

By David T. Day.

PRODUCTION.

The production of platinum in the United States during 1904 was stimulated by a rise in price, amounting to about 10 per cent and due principally to anxiety in regard to the fate of the platinum industry in Russia during the Russo-Japanese war. It should not be understood that the slight rise of 10 per cent in the price of platinum would serve as any great stimulus to the placer gold miners of the West who furnish the platinum products of the United States, for these miners are comparatively indifferent to a slight change in price. The scarcity of platinum, and the consequent rise in price, however, led to much energy on the part of eastern smelters in platinum in urging upon the placer miners of the West the advisability of saving platinum in cleaning up the hydraulic mines. The increase thus effected is interesting as showing what is possible in the United States in the future. The product of 110 ounces in 1903, valued at $2,080, increased to 200 ounces, valued at $4,160 in 1904, all from California and Oregon, inasmuch as operations have been suspended in the Rambler copper mine, Wyoming, which furnished some platinum the year before. The outlook for increased production for the year 1905 is good, not only on account of the continued high price of platinum but because of the investigation undertaken by the United States Geological Survey of the black sands of the Pacific slope and of the increased knowledge thus furnished to the miners in regard to the value of the platinum and to simpler means of saving it. A detailed report of this investigation will be included in the next volume of Mineral Resources of the United States.

A circular letter was addressed to all the placer miners of the United States inviting them to send to the Survey samples of the heavy sands which collect in the sluices. In response to this circular many specimens are under investigation, not only as to the quantity of gold and of platinum metals contained but as to the presence of other useful minerals. This work is under the direction of Prof. Robert H. Richards, of the Massachusetts Institute of Technology. Preliminary assays of some of these sands have already been completed.

WORLD'S SUPPLY.

The world's total supply of platinum for the year amounted to about 300 kilograms or 9,625 troy ounces from South America, and 6,000 kilograms or 192,500 troy ounces from Russia. No production of platinum from Australia was reported. A slight product of both platinum and palladium from the Sudbury copper mines continues to come on the market, but it is not profitable to extract all of the platinum and palladium which these ores could furnish. Increased interest in the occurrence of platinum in hydraulic mines and dredges of the Fraser River is due principally to the fact that the natural alloy of iron and nickel previously found in Josephine County, Oreg., and in Del Norte County, Cal., has also been found in commercial quantity in the Fraser River at Lillooet. Platinum compounds of the crude ore—that is, pure platinum contained in crude grains, is worth at the present time (June, 1905) about $18 to $19 per ounce. Pure platinum ingots are worth $20 per ounce. The average price of platinum wire varies from $20.25 to $20.50 per troy ounce. Sheet platinum anodes are the same price as the wire. Ordinary crucibles and dishes (hammered) are sold at 83 cents per gram or $24.90 per troy ounce, while more complicated platinum wire is only quoted at special prices. Special gages of wire are valued as high as $23 per troy ounce. The imports into the United States during 1905 show a decided decline of more than 8,000 ounces, due to European control of the supply, which also, of course, aided the rise in price. The present prices are the highest that platinum has commanded in recent years.

An interesting and new occurrence of platinum in place in Sumatra has been noted by Prof. L. S. Hundeshagen. These deposits occur in western Sumatra, near the high road at the Singenggoe River, 35 miles from the seacoast. They contain gold as well as small quantities of platinum. The deposits are associated with schists, granite, and augite-diorite. Professor Hundeshagen thinks the present ore deposit was originally a layer of big lenses of limestone imbedded in the old schists, which have been altered into garnet and wollastonite and afterwards mineralized by hot solutions carrying copper, gold, platinum, etc. The slightly decomposed wollastonite with no copper is richest in platinum. Auriferous garnet, poor in wollastonite, contains no platinum. The river sands, adjacent, show gold and platinum. In Borneo platinum found in the diamond placers is in scales, not in grains. The platinum scales carry copper. Although peridotites abound in Borneo, no platinum could be found by the author in their close vicinity, but only traces of gold and metallic copper. In the Indian Archipelago the occurrence of platinum is unusual and is not derived from serpentine.

LITHIUM MINERALS.

By Joseph Hyde Pratt.

SOURCES OF SUPPLY.

There are three different minerals that are mined at the present time for their lithium contents—lepidolite and spodumene, both lithium silicates, and amblygonite, a lithium phosphate. Of these three the last contains the highest percentage of lithia, but thus far has not been found as abundantly as the other two. The only locality at which the amblygonite has been found in quantity is in the vicinity of Pala, San Diego County, Cal. This deposit of amblygonite was discovered in 1902, but there was no production of the mineral until 1904.

All of the lepidolite that is produced in the United States for commercial purposes is obtained from San Diego County, Cal., principally from the vicinity of Pala. There are two other localities in this county at which lepidolite has been found in some considerable quantity, one being near Banner and the other 7 miles east of Julian. No lepidolite was mined at either of these localities during 1904, and only the necessary assessment work was done.

All of the spodumene was obtained from Pennington County, S. Dak., principally from the Etta mine.

The greater part of the lepidolite that has been mined in this country has been exported, while nearly all of the spodumene has been utilized by home chemical manufacturers. From information obtained from the various chemical companies in this country that manufacture lithium compounds it is learned that there is an overproduction of these minerals for domestic consumption, and that unless some new technical uses can be found for the lithium salts, as, for instance, their use on a considerable scale for pyrotechnical purposes, there must be considerable decrease in both the demand and the price for them. The mistaken impression has been prevalent that there was a large demand for lithium minerals, but with their use restricted principally to the manufacture of lithium carbonate the demand is bound to be limited.

All of the lithium minerals that are mined are shipped to New York, where a part is exported and the remainder is reduced by chemical companies.

PRODUCTION.

The quantity of lithium minerals produced in the United States during 1904 amounted to 577 short tons, valued at $5,155. This is a decrease of 578 short tons in quantity and of $18,270 in value, as compared with the production of 1,155 short tons, valued at $23,425, in 1903. Of this 1904 production the greater part was spodumene from South Dakota.

IMPORTS.

In 1904 there were imported into the United States 19 pounds of lithium salts, valued at $48, as compared with 5,596 pounds, valued at $3,669, in 1903. 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 Edmund Otis Hovey.

INTRODUCTION.

The chief ore of antimony is the sulphide (stibnite, or gray antimony) Sb_2S_3, which when pure carries 71.4 per cent of metallic antimony, or 1,428 pounds to the ton. Another important ore is stibiconite, or antimony ocher, the oxide, Sb_2O_3, which at the maximum contains 74.5 per cent, or 1,490 pounds to the ton. Although antimony minerals occur in many localities in the United States and considerable deposits of stibnite are known in South Dakota, Utah, Nevada, and California, the only State reporting a production in 1904 was Arkansas, and the quantity from there ($12\frac{1}{2}$ tons) was an insignificant fraction of the total amount used in the country.

Several circumstances combine to prevent the profitable exploitation of domestic beds of antimony ores. The reduction of antimony from its ores and its alloys with other metals is a difficult, complex, and expensive process, and successful smelting depends upon peculiar conditions; furthermore, foreign ores are abundant and cheap, and the price of the refined metal is comparatively low, so that domestic ores do not repay the cost of transportation, and hence domestic deposits are allowed to remain undeveloped.

PROPERTIES AND USES.

Antimony is a white, very brittle metal, of laminated or crystalline texture. It fuses at a low temperature and readily vaporizes. It is not used in the pure state, but it forms several valuable alloys and compounds. The most important alloys of antimony are type metal, britannia, pewter, and antifriction metals. Type metal consists, essentially, of lead and antimony, often with the addition of small quantities of tin and nickel or copper. Britannia is a white-metal alloy of antimony with tin, copper, and bismuth, and is much used for tableware.

Pewter is a similar alloy, but it contains a smaller percentage of antimony than britannia. There are several antifriction alloys which usually go under the name of babbitt metals One of these consists of 50 parts of tin to 5 of antimony and 1 of bismuth, but other proportions are in use. The addition of antimony to lead hardens it, and the addition of a small quantity of bismuth gives the alloy the property of expanding at the moment of solidification from a molten state, thus producing a perfect cast from a mold.

Among the useful chemical compounds of antimony may be mentioned tartar emetic, a double tartrate of potassium and basic antimony, which is employed for medicinal purposes and as a mordant in dyeing vegetable fibers; a mixture of antimony trisulphide and antimony trioxide, which forms a flame-red pigment, known as antimony cinnabar, and used somewhat in painting; and antimony pentasulphide, which is used in vulcanizing rubber and gives a red color to the product.

PRODUCTION.

The production of metallic antimony in the United States from domestic ore during the year 1904 was practically nothing, only 25,000 pounds being reported, with a valuation of $396. No production from domestic ores was reported during the years 1902 and 1903.

A large quantity of hard lead or antimonial lead is produced in the United States in the process of smelting impure silver-lead ores. In 1904 the production of this alloy was approximately 21,752,000 pounds, with an antimony content ranging from 23.13 to 32 per cent, and amounting to about 5,142,000 pounds. In 1903 the production of antimonial lead was 21,237,440 pounds, containing about 5,115,319 pounds of antimony. Hard lead is used in the manufacture of the several alloys of antimony. Its price ranges about 20 cents per 100 pounds less than that of soft lead.

The annual production of antimony in the United States from 1880 to 1904, 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, 1880–1904.

[Short tons.]

Year.	Contained in hard lead.[a]		Produced from foreign and domestic ores.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1880	([b])	....	50	$10,000	....	....
1881	([b])	....	50	10,000	....	....
1882	([b])	....	60	12,000	....	....
1883	([b])	....	60	12,000	....	....
1884	([b])	....	60	12,000	....	....
1885	([b])	....	50	10,000	....	....
1886	([b])	....	35	7,000	....	....
1887	([b])	....	75	15,000	....	....
1888	([b])	....	100	20,000	....	....
1889	([b])	....	115	28,000	....	....
1890	809	$136,752	129	40,756	938	$177,508
1891	1,011	170,950	278	47,007	1,289	217,957
1892	1,260	219,950	metallic 150 ore 380	56,466	1,790	276,416
1893	1,253	225,540	250	45,000	1,503	270,540
1894	1,187	213,706	200	36,000	1,387	249,706
1895	1,563	236,169	[c]450	68,000	2,013	304,169
1896	1,877	263,249	[c]601	84,290	2,478	347,539
1897	2,217	320,356	[c]844	121,944	3,061	442,300
1898	2,118	348,051	[c]1,120	184,050	3,238	532,101
1899	1,586	307,314	[c]1,275	251,875	2,861	559,189
1900	2,476	490,916	[c]1,750	346,980	4,226	837,896
1901	2,235	457,150	[d]403	82,752	2,639	539,902
1902	2,904	505,340	[d]657	129,166	3,561	634,506
1903	2,558	445,092	[d]570	103,341	3,128	548,433
1904	2,571	[e]443,598	[f]486	[e]61,926	3,057	505,524

[a] Estimated at 25 per cent of the total quantity of hard lead produced from both foreign and domestic ores, except for the year 1902, when an average of 27 per cent was taken.
[b] No statistics available.
[c] Principally from imported ores.
[d] Exclusive of foreign ores imported and reexported.
[e] Estimated from the prices current for the year.
[f] Estimated from the average content of the ore.

IMPORTS.

The following table gives the annual imports of antimony metal and regulus and crude antimony and ore entered for consumption within the country from 1867 to 1904, as reported by the Bureau of Statistics of the Department of Commerce and Labor. The quantity of ore imported increased rapidly from 116,495 pounds in 1893 to 6,089,134 pounds in 1900. This maximum was greatly in excess of the needs of the country, as is shown by the imports (1,682,301 pounds of ore) for the following year. During 1904 the quantity of antimony ore imported into the United States and entered for consumption was 2,288,518 pounds, valued at $50,414, whereas in 1903 the quantity was 2,714,617 pounds, valued at $54,316, a decrease in quantity, but a slight increase in average price per pound.

Antimony and antimony ore imported and entered for consumption in the United States, 1867–1904.

[Pounds.]

Yead ending—	Metal and regulus.		Crude antimony and ore.		Total value.
	Quantity.	Value.	Quantity.	Value.	
June 30—					
1867	....	$63,919	....	....	$63,919
1868	1,033,336	83,822	....	....	83,822
1869	1,345,921	129,918	....	....	129,918
1870	1,227,429	164,179	....	....	164,179
1871	1,015,039	148,264	....	$2,364	150,628
1872	1,933,306	237,536	....	3,031	240,567
1873	1,166,321	184,498	....	2,941	187,439
1874	1,253,814	148,409	....	203	148,612
1875	1,238,223	131,360	6,460	609	131,969
1876	946,809	119,441	8,321	700	120,141
1877	1,115,124	135,317	20,001	2,314	137,631
1878	1,256,624	130,950	20,351	1,259	132,209
1879	1,380,212	143,099	34,542	2,341	145,440
1880	2,019,389	265,773	25,150	2,349	268,122
1881	1,808,945	253,054	841,730	18,199	271,253
1882	2,525,838	294,234	1,114,699	18,019	312,253
1883	3,064,050	286,892	697,244	11,254	298,146
1884	1,779,337	150,435	231,360	6,489	156,924
1885	2,579,840	207,215	215,913	7,497	214,712
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	1,433,531	36,232	363,539
1892	3,950,864	392,761	192,344	7,338	400,099
1893	2,780,432	243,341	116,495	5,253	248,594
1894	2,653,487	193,988	375,468	[a] 18,805	212,793
1895	3,499,901	223,968	668,610	14,718	238,686
1896	2,576,371	158,975	1,180,828	21,402	180,377
1897	2,282,245	143,370	3,719,186	55,400	198,770
1898	2,103,599	148,671	3,749,222	50,256	198,927
1899	2,990,915	241,685	3,968,654	47,427	289,112
1900	3,654,822	287,937	6,089,134	75,866	363,803
1901	3,640,505	254,529	[b] 1,682,301	22,720	278,066
1902	5,388,739	333,601	[b] 3,129,069	62,968	396,569
1903	4,694,309	260,144	2,714,617	54,316	314,460
1904	3,404,045	248,626	2,288,518	50,414	299,040

[a] Includes $737, value of ground antimony for which no quantity was given.
[b] Excludes exports.

CONSUMPTION.

The consumption of antimony in the United States from 1880 to 1904 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; for 1903, when the reported average was 24.1 per cent; and for 1904, when the average was 23.64 per cent.

Estimated consumption of antimony in the United States, 1880–1904.

[Short tons.]

Year.	Contained in hard lead.	From domestic ores.	From imported ores and crude antimony.	Imported metal or regulus.	Total.
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	[b] 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
1904	2,571	5	481	1,702	4,759

[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.

WORLD'S PRODUCTION.

The following table, showing the output and value of antimony metal of the world from 1901 to 1903, has been compiled from the official governmental reports of the respective countries:

World's production of antimony metal in 1901, 1902, and 1903.

[Short tons.]

Country.	1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States[a]	403	$61,820	657	$129,166	570	$103,341
Austria	126	10,434	26	1,737	....	....
France[b]	1,969	240,000	1,901	207,475	3,029	316,290
Germany[c]	2,783	268,250	3,858	331,188	3,537	334,520
Hungary[d]	777	82,920	753	81,200	807	77,932
Italy	1,898	195,550	1,202	91,236	....	....
Japan	474	58,737	679	67,015	647	53,729
Servia	268	40,824	344	42,492	379	40,225
Total	8,698	958,535	9,420	951,509	....	....

[a] Does not include the antimony contained in hard lead.
[b] Includes product of Algeria.
[c] Includes quicksilver.
[d] Crude antimony and regulus.

PRICES.

During most of the year 1904 the prices of antimony varied but little from 7 to $8\frac{1}{4}$ cents per pound for Cookson's, $6\frac{1}{4}$ to $6\frac{7}{8}$ cents per pound for Hallett's, and $5\frac{5}{8}$ to $6\frac{3}{8}$ cents per pound for the United States, Japanese, French, Hungarian, and Italian brands. Toward the end of the year, however, the effect of the increased demand caused by the Russo-Japanese war began to be felt and prices began to rise. Interest in the market fell off toward the end of December, and the closing quotations were $8\frac{3}{4}$ to $8\frac{7}{8}$ cents per pound for Cookson's, 9 to $9\frac{1}{8}$ cents for Hallett's, and $7\frac{1}{2}$ to 8 cents for othei brands. The following table, which shows the current prices of antimony by months and years from 1896 to 1904, inclusive, has been compiled from the reports published in the Iron Age, the Engineering and Mining Journal, and the Metal Market:

Prices of antimony at New York, 1896–1904, by months.

[Cents per pound.]

Month.	1896.			1897.			1898.		
	Cookson's.	Hallett's.	Japanese.	Cookson's.	Hallett's.	Japanese.	Cookson's.	Hallett's.	Japanese.
January	8¼	7¼ to 7½	7	7¼ to 7½	6½ to 6¾	6⅜ to 6⅝	8 to 8¼	7⅛ to 7¼	7⅛ to 7¼
February	8¼	7½	7	7¼ to 7½	6⅝ to 6⅞	6½ to 6¾	8 to 8¼	7¼ to 7½	....
March	8¼	7½	7	7¼ to 7½	6¾ to 7⅛	6⅝ to 7	8 to 8⅛	7⅝ to 7¾	....
April	8¼	7½	7	7¼ to 7½	7 to 7⅛	7 to 7⅛	8⅛ to 9	7¾ to 8	....
May	8 to 8¼	7¼ to 7½	6⅞ to 7	7¼ to 7⅝	7 to 7¼	6¾ to 7¼	9¼ to 9½	8⅜ to 8¾	8¾
June	8	7¼	6⅞ to 7	7¼ to 7½	6½ to 7	6½ to 6¾	9¼ to 9¾	8¾ to 9	8¾ to 9
July	8	7¼	6⅞ to 7	7 to 7¾	6⅞ to 7½	6¾	9⅝ to 9¾	9	9
August	8	7¼	6⅞ to 7	7 to 8¼	7⅜ to 7½	6¾ to 7	9⅝ to 9¾	9	9
September	8	7¼	6⅞ to 7	8 to 8¼	7¼ to 7½	7 to 7¼	9⅜ to 9¾	9	9
October	7¼ to 7⅜	6½	6⅜	8 to 8½	7¼ to 7½	7 to 7⅛	9⅜ to 9¾	9	9
November	7⅛ to 7⅜	6⅜ to 6½	6¼ to 6⅜	8 to 8½	7¼ to 7½	7 to 7¼	9⅜ to 9¾	9	8⅞ to 9
December	7¼ to 7½	6½	6⅜	8 to 8¼	7¼ to 7⅜	7 to 7¼	9⅝ to 9¾	8¾ to 9	8¾ to 8⅞

Month.	1899.			1900.		1901.		
	Cookson's.	Hallett's.	United States.	Cookson's.	Hallett's.	Cookson's.	Hallett's.	Others.
January	10 to 10⅝	9½ to 9¾	9½	10½ to 11	9¾ to 9⅞	10¼ to 10½	9¼	8⅝ to 9
February	10¼ to 10¾	9½ to 10¼	9½ to 9¾	10½ to 11	9¾ to 10	10¼	9¼	8¾ to 9
March	11½ to 12	10½ to 10¾	10¼ to 10¾	10½ to 11	9¾ to 10	10¼	8¼ to 9¼	8½ to 9
April	11½ to 12	10½ to 10¾	10¼ to 10¾	11	9¾	10¼	8¾ to 9	8½ to 8¾
May	11½ to 12	10½ to 10¾	10¼ to 10½	11	9¾	10¼	8¾ to 9	8½ to 8¾
June	11⅛	10½	10¼	11	9⅝	10¼	8¾	....
July	11½	10½	10¼	10½ to 11	9½ to 9⅝	10¼	8¾	....
August	11½	10½	10¾ to 11	10½	9½	10¼	8½ to 8¾	8¼ to 8½
September	11½	10½	10¾ to 11	10½	9½	10¼	8½ to 8¾	8¼ to 8½
October	11½	10½	10¼	10½	9½	10¼	8⅜ to 8½	8 to 8¼
November	11¼ to 11½	10¼ to 10½	10 to 10½	10½	9½	10¼	8⅜	8 to 8¼
December	11¼ to 11½	10¼ to 10½	10 to 10¼	10½	9½	10¼	8¼ to 8⅜	8 to 8¼

Month.	1902.			1903.			1904.		
	Cookson's.	Hallett's.	Others.	Cookson's.	Hallett's.	Others.	Cookson's.	Hallett's.	Others.
January	10	8 to 8¼	7¾ to 8	8¼ to 8½	7 to 7⅛	6¾ to 6⅞	7 to 8¼	6¼	5⅝
February	10	8 to 8⅛	7¾	8¼ to 8⅜	7 to 7⅛	6⅜ to 6⅞	8 to 8¼	6¾	6¼
March	9¾ to 10	8 to 8⅛	7¾	8¼	6¾ to 7	6½ to 6⅝	8 to 8¼	6⅞	6⅜
April	9¾ to 10	8 to 8⅛	7¾	8¼	6¾ to 6⅞	6½	7⅞ to 8	6¾	6⅜
May	9¾ to 10	8 to 8¼	7¾ to 8	7½ to 8	6¾ to 6⅞	6½	7¾ to 7⅞	6⅝	6¼
June	9¾ to 10	8 to 8¼	8	7½ to 8	6⅝ to 6¾	6⅜ to 6½	7¼ to 7½	6⅜	6
July	9¾	8¼	8	7¼ to 7½	6⅜ to 6⅝	6¼ to 6½	7¼ to 7½	6½	6
August	9¾	8 to 8¼	7¾ to 8	7 to 7½	6⅜ to 6½	5¾ to 6⅜	7 to 7¼	6⅝	6
September	9½ to 9¾	7¾ to 8	7¼ to 7¾	7 to 7¼	6¼ to 6⅜	5¾ to 6¼	7	6½	6
October	9 to 9¾	7½ to 7¾	7¼ to 7½	7 to 7¼	6¼ to 6⅜	5¾ to 6¼	7 to 7½	6⅝	6⅛
November	9 to 9½	7⅜ to 7⅝	7⅛ to 7¼	6¾ to 7¼	6¼ to 6⅜	5⅝ to 6¼	7⅞ to 10	7⅜	7¼
December	9 to 9½	7⅛ to 7⅜	6¾ to 7	6¾ to 7¼	6¼ to 6⅜	5⅝ to 6¼	9 to 10	8⅛	8⅛

ARSENIC.

By Edmund Otis Hovey.

INTRODUCTION.

OCCURRENCE.

Arsenic-bearing minerals are known to occur in many localities throughout the world, but commercially important deposits are few in number. The principal present sources of the world's supply of arsenic and its compounds are Germany, Great Britain, Spain, and Portugal, while small quantities are produced from mines in the United States, Turkey, Italy, and Japan.

The chief direct ore of arsenic is arsenopyrite or mispickel, the sulpharsenide of iron (FeAsS), which contains 46 per cent of metallic arsenic. In some localities the sulphides are important ores. These are realgar ($As_2 S_2$), containing 70.1 per cent metallic arsenic, and orpiment ($As_2 S_3$), with 61 per cent arsenic. Native metallic arsenic has been an important ore in Germany and elsewhere, but it is now of comparatively rare occurrence. Arsenic is also obtained as a by-product from some nickel and cobalt ores, particularly smaltite and cobaltite, and from some copper ores, probably through the association of sulphides of arsenic with the sulphides of copper. Several other minerals contain more or less arsenic as an impurity.

USES.

For commercial purposes arsenic is produced from its ores in the form of arsenious oxide. Its use in the arts is extensive, chiefly as Paris green (the arseniate of copper). Scheele's green, London purple, and many drugs owe their characteristics to their content of arsenic. The colors possessed by certain arsenic salts are beautiful and peculiar, but the highly poisonous nature of all the compounds of this element greatly restricts their use as dyestuffs and pigments. As vermicides, preservatives, and mordants, several arsenic salts find wide employment, while the oxide is an ingredient of certain high grade enamels and glassware.

PRODUCTION IN THE UNITED STATES.

The production of arsenious oxide (the "white arsenic" or simply "arsenic" of commerce) in the United States during 1904 amounted to only 36 short tons 413 pounds, valued at $2,185, as compared with

611 short tons, valued at $36,691, in 1903, and 1,353 short tons, valued at $81,180, in 1902. This marked decrease was due to the fact that the works of the American Smelting and Refining Company, at Everett, Wash., were not operating on arsenical ores during 1904. A description of the process of treatment of arsenical ores at the Everett plant may be found in Mineral Resources for 1903. The works are reported to be in operation again in the current year (1905), and increased production may be looked for in the near future. The United States Arsenic Mines Company, of Pittsburg, Pa., described in Mineral Resources for 1903, began the production of refined material in September, 1904, from its mines, which are at Rewald Post-office, Floyd County, Va. The Mineral Creek Mining and Smelting Company was mining realgar and other arsenic ores at Mineral, Lewis County, Wash., during 1904, and it hopes to produce white arsenic during 1905. Several of the great smelters of the country are reported to be preparing for the saving of arsenical fumes from their furnaces. If this be true, there will soon be rapid increase in the domestic production of this important mineral substance.

Production of arsenic in the United States, 1901–4.

Year.	Quantity.	Value.
	Short tons.	
1901	300	$18,000
1902	1,353	81,180
1903	611	36,691
1904	36.2	2,185

WORLD'S PRODUCTION OF ARSENIC.

The statistics of the world's production of arsenic and its compounds from 1895 to 1904, inclusive, are given in the following table:

The world's annual production of arsenic, 1895–1904.[a]

[Metric tons.]

Year.	Canada.		Germany.[b]		Italy.[b]		Japan.	Portugal.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Quantity.	Value.
	Tons.		*Tons.*		*Tons.*		*Tons.*	*Tons.*	
1895	Nil.	....	3,005	$207,187	100	$8,000	7	....	....
1896	Nil.	....	2,632	221,165	320	24,400	6	....	....
1897	Nil.	....	2,987	295,897	200	18,600	13	524	$20,369
1898	Nil.	....	2,677	253,528	215	15,700	7	751	44,764
1899	52	$4,842	2,423	267,250	304	26,483	5	1,083	61,356
1900	275	22,725	2,414	263,250	126	12,098	5	1,031	62,522
1901	630	41,676	2,549	256,750	6	120	10	527	35,277
1902	726	48,000	2,827	260,000	([c])	([c])	12	736	33,063
1903	233	15,420	2,768	253,500	([d])	([d])	6	698	29,984
1904	[e]66	6,900	....	....	....	....	....	....	....

[a] From official reports of the respective countries.
[b] Metallic arsenic and arsenious oxide.
[c] Not reported.
[d] Statistics not available at time of publication.
[e] Exports.

The world's annual production of arsenic, 1895-1904—Continued.

[Metric tons.]

Year.	Spain.[a]		United Kingdom.[b]		United States.[b]	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	....	....
1901	120	14,400	3,416	197,270	272	$18,000
1902	([c])	([c])	2,165	96,910	1,226	81,180
1903	1,088	87,040	902	30,750	554	36,691
1904	....	....	....	....	33	2,185

[a] Arsenic sulphide; in addition to these quantities, during 1903 there were produced 22 tons of orpiment, valued at $3,337.
[b] Arsenious oxide.
[c] Not reported.

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 1904, inclusive:

Imports of metallic arsenic, white arsenic (arsenious acid), and arsenic sulphides (orpiment and realgar) in the United States, 1893-1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Pounds.			*Pounds.*	
1893	6,092,377	$180,333	1899	9,040,871	$386,791
1894	7,063,442	218,636	1900	5,765,559	265,500
1895	6,984,273	237,747	1901	6,989,668	316,525
1896	5,813,387	215,281	1902	8,110,898	280,055
1897	7,242,004	352,284	1903	8,357,661	294,602
1898	8,686,681	370,347	1904	6,800,235	243,380

PRICES.

The average price per pound of standard English brands of white arsenic during the year 1904 was as follows: January, February, and March, $3\frac{1}{4}$ to $3\frac{1}{2}$ cents; April, May, and June, 3 to $3\frac{1}{8}$ cents; July, August, and September, 3 to $3\frac{5}{8}$ cents; October, November, and December, 3 to $3\frac{3}{8}$ cents.

CANADA.

Dr. W. G. Miller, provincial geologist of Ontario, reports that no white arsenic was produced in Ontario during the year 1904. The only producer in previous years was the Deloro mine, Hastings County, and this mine has been closed for more than a year on account of a strong flow of water encountered in the 500-foot level. Operations will probably be begun again here in the near future. Some mispickel concentrates were produced in the treatment of gold ores at the Atlas arsenic plant, which adjoins the Deloro, but these concentrates were not roasted.

The new arsenic districts of the Province which are now being developed are situated in the vicinity of Lake Temagami and near Cobalt Station on the line of the new Government railway, the Temiskaming and Northern Ontario. Lake Temagami lies a little over 300 miles north of Toronto by rail, and Cobalt Station is about 25 miles farther north.

There are two deposits of mispickel being developed near Temagami. The deposits in which the mineral is found are rather irregular in form, the mineral occurring in bunches or masses and more or less disseminated through greenstone and related schists of the Keewatin system, the term "Keewatin" being used in the sense in which it is used in the new classification agreed to by the international commission on pre-Cambrian nomenclature.

At Cobalt Station the arsenic-holding ores consist essentially of arsenides of cobalt and nickel, such as smaltite, niccolite, chloanthite, etc. Associated with these ores is much native silver, together with several silver minerals, such as pyrargyrite, argentite, dyscrasite, etc. Native bismuth is found in all the deposits, together with tetrahedrite and other ores, a similar assemblage of minerals to that of the well-known Saxon deposits.

It is interesting to find that the iron arsenides of Temagami are auriferous, gold occurring in commercial quantities in these ores; the nickel-cobalt arsenides of Cobalt Station are argentiferous and contain no gold. The latter deposits occur in the form of distinct veins, which cut the almost horizontally lying fragmental rocks of the lower Huronian, which here consists of conglomerates, breccias, slaty-graywackes, etc., in an almost vertical direction.

During the last few months there have been four shipping properties within a radius of half a mile of Cobalt Station. Several other deposits are known, but they are as yet undeveloped. The following analysis represents, approximately, some shipments which have been made from one vein near Cobalt. This vein, unlike the others in the vicinity, does not carry silver in paying amounts.

Analysis of arsenic ore from Cobalt Station, Canada.

	Per cent.
Cobalt	16
Nickel	7
Iron	6 to 7
Arsenic	60 to 65
Sulphur	4 to 5

BISMUTH.

By Edmund Otis Hovey.

INTRODUCTION.

The demand for metallic bismuth and bismuth salts is small, but the quantity of metal which could be placed upon the market is relatively large. During the last year the war in Asia has increased somewhat the demand for some of the salts of bismuth used medicinally and for surgical purposes. The extraction of bismuth from its ores is a complex process, however, and both production and prices are controlled by Johnson, Matthey & Co. (Limited), of England, and the Government of Saxony.

OCCURRENCE.

Bismuth occurs sparingly in the metallic state. The principal ores are the sulphide (bismuthinite), the oxide (bismite), and the basic carbonate (bismutite), and they are scattered widely throughout the Rocky Mountain States. Colorado seems to contain the greatest number of bismuth minerals and the largest quantity of ore, the Leadville district being the only producing region in this country during 1904. Bismuth usually has associated with it more or less gold and silver, so that its extraction is more or less as a by-product of the smelting of the noble metals. The ores of bismuth are very variable in composition. Theoretically it is possible for the sulphide to contain 81.2 per cent metallic bismuth, the oxide 96.6 per cent, and the basic carbonate 80.6 per cent; practically, the bismuth content of the ores as mined runs from 7.5 to 15 per cent. Connecticut, Virginia, and North Carolina have produced handsome cabinet specimens, but the veins have no commercial value. It is reported that near Sodaville, Esmeralda County, Nev., a vein has been opened for 900 feet which is from 20 inches to 4 feet in width and which carries bismuthinite ore that averages 14 per cent bismuth. Near Newfoundland, Boxelder County, Utah, bismuth ore of high grade is reported to occur in association with copper ores.

PRODUCTION.

The marketed production of bismuth ore in the United States in 1904 was 5,184 pounds, valued at $314. No sales were reported in 1903 or 1902. A total of about 83 short tons of crude bismuth ore is reported as having been mined but not sold during 1904. The price of refined metal is kept so low by the combination controlling the business that profitable mining of our domestic ores is practically out of the question.

IMPORTS.

The imports of metallic bismuth into the United States during 1904 were 185,905 pounds, valued at $339,058, as compared with 147,295 pounds, valued at $235,199, in 1903, with 190,837 pounds, valued at $213,704, in 1902, and with 165,182 pounds, valued at $239,061, in 1901. A small quantity of bismuth salts is imported also for chemical and pharmaceutical purposes.

USES.

Bismuth is valuable for the quality it gives its alloys with certain metals, by virtue of which they melt at low temperatures. The chief alloys are with lead, tin, and cadmium, singly or together, and in varying proportions according to the use to which the alloy is to be put. The melting point of the several alloys in common use ranges from 60° C. to 94.5° C, and they form safety fuses for electric apparatus, safety plugs for steam boilers and automatic fire extinguishers, some solders and dental amalgams, matrices for plaster or wax casts, etc. The bismuth alloys are used also for baths in certain operations which require liquids at definite temperatures below that of boiling water.

TIN.

By Joseph Hyde Pratt.

INTRODUCTION.

The source of the world's supply of tin is a matter that is assuming considerable importance, for during the last few years the production of tin in the world has not been equal to the demand, and the accumulated stocks of tin that have been held in various countries have become very much diminished since 1896. One of the chief reasons for this increasing demand for tin is the large growth of the canning industry and also of the use of tin boxes and cases in shipping sundry articles. Of all the tin produced in the world approximately 40 per cent is consumed in the United States, and until the last year or two there has been practically no production of this metal in this country. In 1904, however, tin was produced in Alaska, South Carolina, and South Dakota, and although the production was very small as compared with the total consumption of tin in the United States, it may be the beginning of what may become an important industry in this country. None of this ore is smelted in this country: it has all been shipped to England.

On account of the demand for tin and the high price it brings, a new industry was started a few years ago which is known as "detinning" tin scrap, and this has now become of considerable importance in the United States, and many hundred tons of metallic tin and chemical salts of tin, chiefly chlorides, are obtained each year by the chemical or electrolytic treatment of new tin scrap, which is obtained from tin-can and fruit-can factories. Old tin cans and similar material are subjected to a smelting treatment by which also the tin is recovered; and such tin is either used in a crude and impure condition in the manufacture of solder or is treated chemically to yield metallic tin or tin salts. The residue of iron obtained in these processes, which contains a little tin, is melted and cast into window-sash weights and other objects where the small percentage of tin in the iron is a desirable feature.

On account of the value of the metal tin, it is possible to work very low-grade ores if they are in quantity, and usually there is but little difficulty in cleaning and concentrating a tin ore so as to obtain nearly pure concentrates. Cassiterite, a tin dioxide, represented by the formula SnO_2, is the usual tin ore, a heavy mineral, having a specific gravity of about 6.5 to 7.

Considering the existing conditions in the tin industry, it is no wonder that any new discovery of tin ore arouses considerable interest, and that capital is available for development of the deposits to prove their actual commercial value. During the last year development work has been continued at the tin deposits in the vicinity of Kings Mountain, N. C., and near Gaffney, S. C.; at the Tinton deposits of South Dakota, and at the Buck Creek deposits of Alaska; and from all three of these localities there was a small production of tin ore.

PRODUCTION.

During 1904 the production of tin ore in the United States amounted to 159 short tons, which contained from 40 to 70 per cent of metallic tin and was obtained from South Carolina, South Dakota, and Alaska. Nearly all of this tin ore or cassiterite concentrates was shipped to England for smelting.

WORLD'S PRODUCTION OF TIN.

On account of the output of the metal tin being largely from countries where no accurate statistics of the production can be obtained, it is only possible to give approximate figures regarding the world's production. In the following table there is given an approximate idea of the production of tin, by countries, during the last eight 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, 1897–1904.[a]

[Long tons.]

Country.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Malay States	44,914	45,901	45,944	47,855	52,989	53,756	54,797	58,657
Banka and Billiton	14,800	14,380	14,123	16,640	19,365	18,765	20,060	14,638
Bolivia	5,506	4,464	4,753	6,937	9,670	10,150	9,500	9,200
Cornwall, England	4,453	4,648	4,013	4,268	4,125	3,950	4,150	4,282
Australia	3,466	2,420	3,337	3,178	3,276	3,206	4,991	5,082
Miscellaneous[b]	360	655	970	760	450	350	395	384
Total[c]	73,499	72,468	73,140	79,638	89,875	90,177	93,893	92,243

[a] Mineral Resources U. S. for 1903, U. S Geol. Survey, 1904, p. 345; Eng. and Min. Jour., Jan. 12, 1905, p. 76.
[b] Includes production in Austria, Germany, Japan, Mexico; in 1903 from South Carolina, and in 1904 from South Carolina, South Dakota, and Alaska.
[c] This does not include the production of China.

As is seen from this table, there was a slight decrease, amounting to 1,650 long tons, in the estimated production of tin in 1904 as compared with 1903. The consumption of tin in 1904 was considerably more than the actual production, which for a number of years has been practically stationary, the lack of production being made up from the accumulated stocks of tin at various ports. The consumption of tin during 1904 has been estimated at approximately 94,755 tons.[a] These figures compared with the world's production show that the consumption of tin in 1904 was greater than the production by 2,512 long tons. Of this quantity about 40 per cent is consumed in the United States. In the following table are given the estimated quantities of tin consumed in the various countries:

Consumption of tin in the world during 1904.[a]

Country.	Quantity.	Percentage.
	Long tons.	
United States	38,500	40.6
Great Britain	15,898	16.8
Germany	14,832	15.7
France, Italy, Spain and Russia	17,920	18.9
Eastern Europe and South America	4,305	4.5
Eastern Asia	3,300	3.5
Total consumption	94,755	100.0

[a] Eng. and Min. Jour., Jan. 12, 1905, p. 76.

IMPORTS.

The tin imported into the United States for the fiscal year ending June 30, 1904, 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 for each for the years 1903 and 1904:

Imports of tin into the United States for the years ending June 30, 1903 and 1904.

Country.	Tin in bars, blocks, pigs, or grain or granulated.			
	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Malay Peninsula[a]	23,592	$12,715,875	16,579	$8,725,824
Great Britain and Dominion of Canada	17,591	9,374,563	21,799	11,720,453
Netherlands	1,726	944,304	934	466,109
Other European countries	833	441,114	334	183,184
Australia	224	119,851	309	164,213
Japan	[b] 42	23,095	11	5,945
Other countries			416	220,583
Total	44,008	23,618,802	40,382	21,486,311

[a] Including British East Indies and Hongkong.
[b] Includes very small quantities from China and Mexico.

It will be seen from this table that the quantity quoted as having been imported from Great Britain in 1904 is nearly five times that produced in England, and 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. The tin exported from the Netherlands represents the metal obtained from the islands of Banka and Billeton, and some of the tin imported from other European countries was obtained from Bolivia. From this it will be seen that the greater part of the tin consumed in the United States is produced in the Malay Peninsula.

The following table shows the imports for consumption of tin into the United States for the calendar years from 1898 to 1904, inclusive:

Tin imported and entered for consumption in the United States, 1898–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Pounds.			*Pounds.*	
1898	62,748,399	$8,770,221	1902	85,043,353	$21,263,337
1899	71,248,407	16,748,107	1903	83,133,075	22,265,336
1900	69,989,502	19,458,586	1904	82,944,046	22,356,895
1901	74,560,487	19,024,761			

PRICES.

The following table shows the average monthly prices of tin in New York from 1899 to 1904:

Average monthly prices of tin per pound in New York, 1899–1904.

[In cents.]

	1899.	1900.	1901.	1902.	1903.	1904.[a]
January	22.48	27.07	26.51	23.54	28.33	28.84
February	24.20	30.58	26.68	24.07	29.43	28.09
March	23.82	32.90	26.03	26.32	30.15	28.32
April	24.98	30.90	25.93	27.77	29.81	28.13
May	25.76	29.37	27.12	29.85	29.51	27.72
June	25.85	30.50	28.60	29.36	28.34	26.33
July	29.63	33.10	27.85	28.38	27.68	26.57
August	31.53	31.28	26.78	28.23	28.29	27.01
September	32.74	29.42	25.31	26.60	26.77	27.78
October	31.99	28.54	26.62	26.07	25.92	28.59
November	28.51	28.25	26.67	25.68	25.42	29.18
December	25.88	26.94	24.36	25.68	27.41	29.28
Year	25.12	29.90	26.54	26.79	28.09	27.99

[a] Eng. and Min. Jour., Jan. 12, 1905, p. 77.

As is seen, the prices of 1904 decreased rapidly from January to June, when there was a steady increase until, at the close of December, they were higher than at the beginning of the year. This is just the reverse of the record for the year 1903, when the prices for the first part of the year were considerably higher than for the last part, the closing price being considerably lower than the opening price.

COAL.

By Edward W. Parker.

INTRODUCTION.

The most important feature connected with the coal-mining industry of the United States in 1904 was the reaction from the high level of prices and the consequently large total value of the product which made 1903 a notable year in the history of coal mining. The great strike in the anthracite regions of Pennsylvania in 1902 had not only depleted all stocks of hard coal, but those of bituminous coals as well, practically all over the country; and during the first few months of 1903 the demand for both kinds of fuel, to replete stocks and at the same time provide for immediate necessities, had the effect of maintaining, well into the spring, the abnormally high prices that prevailed during the strike. As a result of these conditions the production of all kinds of coal in 1903 increased enormously, the total for the year exceeding that of 1902 by over 55,000,000 short tons, while a gain of over $136,500,000, or nearly $2.50 on every ton of increased product, was shown in the total value, which exceeded $500,000,000.

The statistics presented in the following pages show that the production in 1904 was less than that of 1903, but the decrease was insignificant when considered with the extraordinary conditions of the preceding year, and indicates the continuance of rather than an interruption to the generally prosperous conditions which have prevailed during the last eight years. It is true that there was some falling off in the iron trade during 1904, and that the lessened demand for fuel in this industry was no doubt in part responsible for the fact that the coal production last year was not equal to that of 1903. But as the decrease was so small and as the average price, although much below that of 1903, was higher than at any time in recent years previous to 1902, a generally healthy condition of business is indicated. The difference between the values of the production in 1903 and 1904 was over $55,000,000.

While the number of suspensions of work because of labor troubles in 1904 was larger than in 1903, there were only two or three States in which the time lost was sufficient to influence the production. The principal troubles were in Alabama in the East and in Colorado in the West. Relations between operators and mine workers in the anthracite regions of Pennsylvania were for the most part harmonious, such troubles as occurred being settled by the Board of Conciliation, whose good work in its efforts to conscientiously carry out the provisions of the awards made by the Anthracite Coal Strike Commission deserves to be highly commended.

One of the features of the present report, which will possibly prove of interest, is a table showing a comparison of the hours worked per day in 1903 and 1904. These statistics are not entirely complete, as there were many operators who failed to reply to this inquiry on the schedules. Moreover, it is well known that whatever the hours worked by the "company" men, the contract miner (and practically all of the coal is mined on a contract basis) is not bound thereby, and all statistics relating to working hours are subject to this modifying influence. It appears, however, that there is a tendency toward shorter hours and that the majority of the mines, particularly in the States where the miners are well organized, were operated on an eight-hour basis. The statistics for 1904 show that the daily productive capacity per man in that year in the production of anthracite was less than in 1903, while there was an increase in the daily production per man in the bituminous regions. The increased productiveness per man in the bituminous regions is partly accounted for by an increase in the use of mining machines for undercutting coal. It is to be noted further that while the production of both anthracite and bituminous coal in 1904 was less than it was in 1903, there was an increase in the number of men employed, and a decrease in the average number of days worked, with a corresponding decrease in the average tonnage per man for the year in both anthracite and bituminous mines. The statistics for 1904 show that the average production per man in the anthracite region for the entire year was 469 short tons, as compared with 496 tons in 1903, while the average daily production per man decreased from 2.41 tons to 2.35 tons. The average production of bituminous coal per man in 1904 was 636 tons, against 680 tons in 1903, while the daily production per man increased from 3.02 to 3.15 tons. The average number of working days in the anthracite field decreased from 206 in 1903 to 200 in 1904, while the average number of days in the bituminous mines decreased from 225 in 1903 to 202 in 1904.

As a general thing the improvements in transportation facilities which were noted as obtaining in 1903, as compared with 1902, continued during 1904, although there were some regions where shortness of car supply and discrimination in this particular were causes of complaint among the operators. This was notably the case in some portions of West Virginia, where in many cases the mines were shut down from three to four days in a week because of lack of cars.

Since 1899 the United States has held first place among the coal-producing countries of the world, and each year since that time has increased its lead over Great Britain and the other more important producers. This country now contributes about one-third of the entire coal supply, and consumes from 97 to 98 per cent of its own production.

ACKNOWLEDGMENTS.

The statistics contained in these reports could not be secured in their completeness 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 these sources. 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 fields 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 1904 183,014,200 short tons, or 65.56 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 1904 51,774,503 short tons, or 18.55 per cent of the total. The Western coal field, the third in productive importance, contains 94,076 square miles, and produced in 1904 23,273,482 short tons, or 8.34 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 1904 16,338,716 short tons, or 5.85 per cent of the total.

Brief descriptions of the coal fields of each State are given in the subsequent pages, in connection with the discussion of the production of coal by States. 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 United States, grouped according to the divisions mentioned above, with the total output of each from 1899 to 1904:

Coal fields of the United States and their production, 1898–1904.

	Area.	1899.	1900.	1901.	1902.	1903.	1904.
Anthracite.	*Sq. miles.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
Pennsylvania	484	60,418,005	57,367,915	67,471,667	41,373,595	74,607,068	73,156,709
Colorado and New Mexico	16	96,196	98,404	66,869	93,937	72,731	72,074
Total	500	60,514,201	57,466,319	67,538,536	41,467,532	74,679,799	73,228,783
Bituminous.[a]							
Triassic:							
Virginia	270	28,353	57,912	12,000	16,206	18,084	2,100
North Carolina	800				23,000	17,309	7,000
Appalachian:							
Pennsylvania	15,800	74,150,175	79,842,326	82,305,946	98,574,367	103,117,178	97,952,267
Ohio	12,000	16,500,270	18,988,150	20,943,807	23,519,894	24,838,103	24,434,812
Maryland	510	4,807,396	4,024,688	5,113,127	5,271,609	4,846,165	4,813,622
Virginia	1,850	2,104,334	2,353,576	2,725,873	3,166,787	3,433,223	3,581,814
West Virginia	17,280	19,252,995	22,647,207	24,068,402	24,570,826	29,337,241	32,602,819
Eastern Kentucky	10,300	1,871,550	2,222,867	2,268,892	3,019,757	3,158,972	3,201,418
Tennessee	4,400	3,330,659	3,509,562	3,633,290	4,382,968	4,798,004	4,782,211
Georgia	167	233,111	315,557	342,825	414,083	416,951	383,191
Alabama	8,500	7,593,416	8,394,275	9,099,052	10,354,570	11,654,324	11,262,046
Total	70,807	129,843,906	142,298,208	150,501,214	173,274,861	185,600,161	183,014,200
Northern:							
Michigan	11,300	624,708	849,475	1,241,241	964,718	1,367,619	1,342,840
Central:							
Indiana	9,300	6,006,523	6,484,086	6,918,225	9,446,424	10,794,692	10,934,379
Western Kentucky	5,800	2,735,705	3,106,097	3,201,094	3,747,227	4,379,060	4,365,064
Illinois	42,900	24,439,019	25,767,981	27,331,552	32,939,373	36,957,104	36,475,060
Total	58,000	33,181,247	35,358,164	37,450,871	46,133,024	52,130,856	51,774,503
Western:							
Iowa	20,000	5,177,479	5,202,939	5,617,499	5,904,766	6,419,811	6,519,933
Missouri	23,000	3,025,814	3,540,103	3,802,088	3,890,154	4,238,586	4,168,308
Nebraska	3,200	....	....	....	....	....	....
Kansas	20,000	3,852,267	4,467,870	4,900,528	5,266,065	5,839,976	6,333,307
Arkansas	1,728	843,554	1,447,945	1,816,136	1,943,932	2,229,172	2,009,451
Indian Territory	14,848	1,537,427	1,922,298	2,421,781	2,820,666	3,517,388	3,046,539
Texas	11,300	883,832	968,373	1,107,953	901,912	926,759	1,195,944
Total	94,076	15,320,373	17,549,528	19,665,985	20,727,495	23,171,692	23,273,482

[a] Includes brown coal or lignite, semianthracite, semibituminous, etc., and scattering lots of anthracite.

Coal fields of the United States and their production, 1898–1904—Continued.

	Area.	1899.	1900.	1901.	1902.	1903.	1904.
Bituminous—Continued.							
Rocky Mountain, etc.:	*Sq. miles.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
North Dakota	28,620	98,809	129,883	166,601	226,511	278,645	266,128
Montana	32,000	1,496,451	1,661,775	1,396,081	1,560,823	1,488,810	1,358,919
Wyoming	16,500	3,837,392	4,014,602	4,485,374	4,429,491	4,635,293	5,178,556
Utah	2,000	786,049	1,147,027	1,322,614	1,574,521	1,681,409	1,493,027
Colorado	18,100	4,718,590	5,182,176	5,668,886	7,348,732	7,381,463	6,610,110
New Mexico	2,890	1,012,152	1,263,083	1,050,806	1,007,437	1,511,189	1,428,496
Idaho		20	10		2,030	4,250	3,330
Nevada							150
Total	100,110	11,949,463	13,398,556	14,090,362	16,149,545	16,981,059	16,338,716
Pacific coast:							
Washington	450	2,029,881	2,474,093	2,578,217	2,681,214	3,193,273	3,137,681
Oregon	320	86,888	58,864	69,011	65,648	91,144	111,540
California	280	160,972	171,708	151,079	84,984	104,673	78,888
Alaska		1,200	1,200	1,300	2,212	747	694
Total	1,050	2,278,941	2,705,865	2,799,607	2,834,058	3,389,837	3,328,803
Total production, including colliery consumption		253,741,192	269,684,027	293,299,816	301,590,439	357,356,416	352,310,427

Total production of each field, 1887–1904.

	Anthracite.	Bituminous.		
		Triassic.	Appalachian.	Northern.
Area ....square miles..	500	1,070	70,807	11,300
Year.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*
1887	39,548,255	30,000	55,888,088	71,461
1888	43,971,688	33,000	60,966,245	81,407
1889	45,600,487	49,633	62,972,222	67,431
1890	46,468,641	29,608	73,008,102	74,977
1891	50,665,931	37,645	77,984,563	80,307
1892	52,537,467	43,889	83,122,190	77,990
1893	54,061,121	36,878	81,207,168	45,979
1894	51,992,671	68,979	76,278,748	70,002
1895	58,066,516	82,682	90,167,596	112,322
1896	54,425,573	103,483	90,748,305	92,882
1897	52,680,756	116,950	97,128,220	223,592
1898	53,429,739	38,938	114,239,156	315,722
1899	60,514,201	28,353	129,843,906	624,708
1900	57,466,319	57,912	142,298,208	849,475
1901	67,538,536	12,000	150,501,214	1,241,241
1902	41,467,532	39,206	173,274,861	964,718
1903	74,679,799	35,393	185,600,161	1,367,619
1904	73,228,783	9,100	183,014,200	1,342,840

Total production of each field, 1887-1904—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
1904	51,774,503	23,273,482	16,338,716	3,328,803

The following table shows the development of the six principal bituminous areas since 1887, giving the quantity produced in each field in that year and the production of each field from 1900 to 1904, inclusive, with percentages of the total contributed by each and with the increases in 1904 as compared with 1887, and the increases and decreases in 1904 as compared with 1903:

Production of the six principal bituminous coal fields in 1887, 1900, 1901, 1902, 1903, and 1904, compared.

Field.	1887.		1900.		1901.		1902.	
	Quantity.	Per cent of total.	Quantity.	Per cent of total.	Quantity.	Per cent of total.	Quantity.	Per cent of total.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Appalachian	55,888,088	63.11	142,298,208	67.00	150,501,214	66.7	173,274,861	66.60
Central	14,478,883	16.50	35,358,164	16.60	37,450,871	16.6	46,133,024	17.73
Western	10,172,634	11.49	17,549,528	8.30	19,665,985	8.7	20,727,495	7.97
Northern	71,461	.08	849,475	.40	1,241,241	.5	964,718	.37
Rocky Mountain	3,646,280	4.15	13,398,556	6.30	14,090,362	6.2	16,149,545	6.21
Pacific coast	854,308	1.00	2,705,865	1.27	2,799,607	1.2	2,834,058	1.07

Production of the six principal bituminous coal fields in 1887, 1900, 1901, 1902, 1903, and 1904, compared—Continued.

Field.	1903.		1904.		Increase in 1904 over 1887.		Increase in 1904 over 1903.	
	Quantity.	Per cent of total.	Quantity.	Per cent of total.	Quantity.	Per cent.	Quantity.	Per cent.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Appalachian	185,600,161	65.64	183,014,200	65.56	127,126,112	227.47	[a]2,585,961	[a]1.39
Central	52,130,856	18.43	51,774,503	18.55	37,295,620	257.59	[a]356,353	[a].68
Western	23,171,692	8.20	23,273,482	8.34	13,100,848	128.78	101,790	.44
Northern	1,367,619	.48	1,342,840	.48	1,271,379	1,779.12	[a]24,779	[a]1.81
Rocky Mountain	16,981,059	6.01	16,338,716	5.85	12,742,436	348.46	[a]642,343	[a]3.78
Pacific coast	3,389,837	1.20	3,328,803	1.19	2,474,495	289.65	[a]61,034	[a]1.80

[a] Decrease.

PRODUCTION.

Total production in 1904, 352,310,427 short tons: spot value, $444,816,288.

Pennsylvania anthracite.—Total production in 1904, 65,318,490 long tons (equivalent to 73,156,709 short tons); spot value, $138,974,020.

Bituminous and lignite.—Total production, 279,153,718 short tons; spot value, $305,842,268.

Compared with 1903 the total output of all kinds of coal in the United States in 1904 exhibits a decrease of 5,045,989 short tons in quantity and of $58,908,093 in value. While these comparisons exhibit a proportionately large decrease in the value, they do not in reality indicate any interruption to the generally prosperous conditions which have prevailed during the last eight years and which have been shared by the coal-mining industry. It is true that a reaction from the high tide of activity which prevailed in the iron trade during 1903 was experienced during 1904, and a considerable falling off in demand from the blast furnaces for both coal and coke was experienced. This is particularly shown by the decrease in the amount of coal made into coke during 1904, this factor alone showing a decrease of nearly 2,500,000 tons as compared with 1903. In fact, all things considered, a much larger decrease in coal production in 1904 was to have been anticipated.

During the first few months of 1903 the coal mines of the United States, both anthracite and bituminous, were pushed to their utmost capacity in order to renew stocks which had been entirely depleted by the strike in the anthracite region of Pennsylvania during the preceding year and also to meet the requirements for immediate consumption. Moreover, the high prices which had been caused by the famine of the preceding year continued well into the spring of 1903 and did not return to the normal level until the summer months. As a result of these conditions, the enormous production of 357,356,416 short tons was recorded, while the total value exceeded $500,000,000. The smaller production in 1904 was simply a natural reaction from the extraordinary conditions obtaining during the previous year, and although the net decrease in value was much greater in proportion, the average price per ton in both anthracite and bituminous coal in 1904 was higher than for any year from 1888 to 1901, or the fourteen years preceding the anthracite strike of 1902.

The decreased production in 1904 was divided proportionately between anthracite and bituminous tonnage. The production of anthracite coal in Pennsylvania decreased from 66,613,454 long tons in 1903 to 65,318,490 tons in 1904, a decrease of 1,294,964 long tons, or 1.9 per cent. The production of bituminous coal decreased from 282,749,348 short tons in 1903 to 279,153,718 short tons in 1904, a loss of 3,595,630 short tons, or 1.3 per cent. The value of the anthracite production decreased from $152,036,448 to $138,974,020, a loss of $13,062,428, or 8.6 per cent, while the value of the bituminous product declined from $351,687,933 to $305,842,268, a decrease of $45,845,665, or 13.04 per cent. The average price per long ton for the marketed sizes of anthracite coal in 1904 was $2.35, as compared with $2.50 in 1903, $2.35 in 1902, and $2.05 in 1901. The coal used at the mines in the anthracite region is composed principally of culm, or waste, upon which no value is placed, and this factor is not considered in estimating the value of the total production. The average price per short ton for the bituminous coal production in 1904 was $1.10, compared with $1.24 in 1903, $1.12 in 1902, and $1.05 in 1901.

In considering the value of the coal as given in these reports, it is to be remembered that the valuation is based upon all the coal produced and sold. A considerable portion of both the anthracite and bituminous coal is sold at much less than the cost of production. The public is apt to note critically the wide discrepancy between the prices shown by these averages and those which it is obliged to pay for its fuel, forgetting that all the profits on the mining operations in the anthracite region have to be made on the sizes above pea coal, which represent only a little more than 60 per cent of the total production, while in the bituminous regions a large proportion of the coal is marketed as screened coal and the sizes below nut are also sold at less than actual cost. The proportion of run-of-mine coal sold is becoming less each year.

The growth of the coal-mining industry in the United States during the last twenty-five years has been remarkably rapid. The output in 1904 was more than double that of 1894, nearly three times that of 1884, and nearly five times that of 1880. The total production of coal in the United States amounted to 100,000,000 short tons for the first time in 1882. In 1890, or eight years later, the total production exceeded 150,000,000 tons, and seven years later, in 1897, it exceeded

200,000,000 tons. It reached a total of a little over 300,000,000 tons in 1902, and has exceeded 350,000,000 tons in both 1903 and 1904. The increase of over 50,000,000 tons in 1903 over 1902 is equal to the 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. On 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 33,035,580 short tons, a per capita average of 0.857 ton. Ten years later, when the population was 50,155,783, the coal output amounted to 71,481,570 short tons, or 1.43 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 1904 to be 83,000,000 people, the per capita production for that year is found to be 4.24 tons.

The United States continues to stand at the head of the coal-producing countries of the world, a position which it has held since 1899, in which year the coal production of the United States for the first time exceeded that of Great Britain. The steps by which this position has been gained are discussed more fully on subsequent pages of this report, under the title, "The world's production of coal." In 1904 the United States exceeded the production of Great Britain, which stands second, by 91,997,787 short tons, or 35.3 per cent. It was nearly twice that of Germany, which comes third, and nearly three times the combined production of Austria-Hungary, France, and Belgium, which rank fourth, fifth, and sixth, respectively.

Notwithstanding the decreased production in 1904, the statistics relating to the use of undercutting machinery in the mining of bituminous coal show an increase in the total amount produced by the use of machines. In 1903 there were 6,658 machines in use and they produced a total of 77,974,894 short tons, or 28.18 per cent of the total production of the States in which mining machines were used. The returns for 1904 show that there were 7,671 machines in use, an increase of 1,013 over the preceding year, while the machine-mined product amounted to 78,692,497 short tons, or 28.78 per cent of the total production in the States in which mining machines were used. The large increase in the number of machines reported, considered with the comparatively small increase in the machine-mined tonnage, indicates that a large number of the machines installed in 1904 were not put in operation until late in the year.

In 1902 there were 5,418 machines used in the production of 69,611,582 short tons, and in 1901 there were 4,341 machines in use, while the machine-mined product amounted to 57,843,335 short tons. By comparing the production by the use of machines during the last four years, it is seen that the average output for each machine in 1901 was 13,325 short tons; in 1902 it was 12,848 short tons; in 1903 it was 11,712 short tons, and in 1904 it was 10,258 short tons, showing that there has been a constantly decreasing tonnage for each machine since 1901. Of the total number of machines in use in 1904, 4,491 were of the pick or plunger type; 3,102 were chain-breast machines, and 78 were of the long-wall pattern. The largest number of both pick and chain machines was in use in the bituminous mines of Pennsylvania, while nearly 50 per cent of the long-wall machines were employed in the mines of Missouri.

A seemingly inconsistent fact, shown in a comparison of the labor statistics in 1904 and 1903, is the larger number of men employed in both the anthracite and bituminous mines in spite of the decreased production in both cases. The total number of men and boys employed in the coal mines of the United States in 1904 is 594,768, as compared with 566,260 men and boys employed in 1903. Of these, 155,861 were employed in the anthracite mines of Pennsylvania in 1904, against 150,483 in 1903, while 438,907 were employed in the bituminous mines in 1904, against 415,777 in 1903. In 1904 the average production per each employee in the anthracite region was 469 tons, against 496 tons in 1903, and the average bituminous production for each employee in 1904 was 636 tons, against 680 tons in 1903. These figures are partly explained by the fact that the number of working days in both the anthracite and the bituminous mines in 1904 was less than in 1903, the average number of days in the anthracite mines being 200 in 1904, against 206 in 1903, and in the bituminous mines 202 days, as compared with 225 days. There was also a decrease in the average tonnage per day per man from 2.41 to 2.35 in the anthracite region, while the average bituminous tonnage per day per man increased from 3.02 to 3.15.

The statistics of coal production for the last fifteen years show that the average working time made in the anthracite region is considerably less than that made in the bituminous region. The average number of days worked in the anthracite region during 1903 and 1904 was considerably above normal, and the average time made in the bituminous mines in 1904 was less than in any year since 1897. Eliminating the number of men employed in each case, and considering only the average number of days made during the last fifteen years, the average time for the anthracite region for the period was 181 days, while the bituminous mines averaged 212 days. The best records made in the anthracite mines during the fifteen years were in 1903, when the men averaged 206 days, and in 1891, when an average of 203 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.

Practically the entire output of both the anthracite and bituminous coal of the United States is consumed within the country. The total exports in 1904 amounted to 9,602,340 short tons, which, deducted from the production of 352,310,427 tons, shows the domestic consumption to have amounted to 342,708,087 short tons. If to this are added the imports, which in 1904 amounted to 1,818,074 short tons, the total consumption of coal in the United States, considering as negligible the stocks on hand, is shown to have been 344,526,161 short tons, which is equivalent to 97.8 per cent of the total domestic production. Most of the coal imported into the United States is classed as bituminous or shale, only a comparatively small amount of anthracite being brought into the country. The imports of bituminous coal are principally to points on the Pacific coast and to the port of Boston, where considerable quantities of bituminous slack are imported from Canada and used in the Otto-Hoffman coke ovens at Everett, near Boston. The exports of both anthracite and bituminous coal are principally to Canada.

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.

The quantity consumed in coke making in 1904 amounted to 31,356,509 short tons, a decrease of 2,444,909 short tons as compared with 1903, when the amount of coal used in the manufacture of coke was

33,801,418 short tons. The coal shipped to market, used in the manufacture of coke, and sold locally, which is considered as a marketable product, amounted in 1904 to 344,422,632 short tons, as compared with 344,722,763 short tons in 1903, and 291,594,578 short tons in 1902. The colliery consumption in the anthracite region, which is not considered in the value of the anthracite product, averages from 8 to 10 per cent of the total anthracite output. In 1902 this proportion was somewhat larger than usual on account of the amount of coal required in keeping the fans and pumps in operation during the strike, while the mines were idle. About 12 per cent of the total anthracite product in 1902 was used for this purpose. At the bituminous mines the amount used for colliery consumption averages between 1½ and 2 per cent of the total product.

There were 31 States and Territories in the United States in which coal was produced in 1904, an increase of one over 1903. A small amount of coal produced in Nevada last year adds that State to the list of those producing coal. Of the 31 States and Territories, including Nevada, there were only 9 in which the output in 1904 exceeded that of 1903, and only 7 in which the value of the product showed an increase. Of the 6 States whose production exceeded 10,000,000 tons, West Virginia and Indiana were the only ones which showed an increase in output in 1904, and even in these cases the values decreased. That of West Virginia showed a decrease of nearly $5,500,000, while the increase in production was over 3,250,000 short tons, and Indiana's production increased 139,687 tons with a decrease in value of $1,139,108. The other States whose production increased were Iowa, Kansas, Kentucky, Oregon, Texas, Virginia, and Wyoming, the largest increases outside of West Virginia being in Wyoming, (543,263 short tons), Kansas, (493,331 short tons), and Texas, (269,185 short tons). The largest decreases were shown in Pennsylvania bituminous, (5,164,911 short tons), Pennsylvania anthracite, (1,450,359 short tons), Colorado, (765,247 short tons), Illinois, (482,044 short tons), Indian Territory, (470,849 short tons), Alabama, (392,278 short tons); and Ohio, (403,291 short tons).

The greatest percentage of increase in the States whose total production exceeded 1,000,000 tons in 1904 was made by Texas, which gained 29 per cent in quantity and 31.8 per cent in value. The greatest percentage of loss among the more important States was sustained by the Indian Territory, which lost 13.4 per cent in both quantity and value, and Colorado, which decreased 10.3 per cent in production and 4.4 per cent in value.

The statistics of the production of coal in the United States in 1903 and 1904, by States, with the distribution of the product for consumption, the total value, and the statistics of the labor employed are shown in the tables following.

Coal production of the United States in 1903, by States.

State or Territory.	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	8,347,507	138,201	305,269	2,863,347	11,654,324	$14,246,798	$1.22	228	21,438
Arkansas	2,142,988	20,408	65,776	....	2,229,172	3,360,831	1.51	223	4,157
California and Alaska	83,339	7,555	14,526	....	105,420	301,318	2.86	301	208
Colorado	5,618,833	243,312	188,565	1,372,892	7,423,602	9,150,943	1.23	245	9,229
Georgia and North Carolina	281,798	899	5,011	146,552	434,260	546,759	1.26	296	730
Idaho	3,000	1,150	100	....	4,250	13,250	3.10	197	32
Illinois	32,911,291	2,785,473	1,232,204	28,136	36,957,104	43,196,809	1.17	228	50,596
Indiana	9,827,374	639,925	324,138	3,255	10,794,692	13,244,817	1.23	197	17,017
Indian Territory	3,329,610	32,610	78,995	76,173	3,517,388	6,386,463	1.82	247	7,704
Iowa	5,379,251	887,745	152,815	....	6,419,811	10,563,910	1.65	226	14,162
Kansas	5,509,846	229,585	96,834	3,711	5,839,976	8,871,953	1.52	215	10,924
Kentucky	6,805,323	380,449	159,589	192,671	7,538,032	7,979,342	1.06	207	14,354
Maryland	4,752,716	53,022	40,427	....	4,846,165	7,189,784	1.48	219	5,859
Michigan	1,203,166	123,677	40,776	....	1,367,619	2,707,527	1.97	222	2,768
Missouri	3,814,688	300,101	123,797	....	4,238,586	6,834,297	1.61	215	9,544
Montana	1,287,322	50,904	63,428	87,156	1,488,810	2,440,846	1.64	254	2,155
New Mexico	1,414,183	24,609	40,276	62,713	1,541,781	2,105,785	1.37	260	1,789
North Dakota	214,671	59,913	4,061	....	278,645	418,005	1.50	198	486
Ohio	23,093,792	1,367,494	375,742	1,075	24,838,103	31,932,327	1.29	194	41,936
Oregon	67,192	9,848	14,104	....	91,144	221,031	2.43	258	235
Pennsylvania	77,987,351	1,572,156	1,863,363	21,694,308	103,117,178	121,752,759	1.18	235	129,265
Tennessee	3,763,428	67,388	65,371	901,817	4,798,004	5,979,830	1.25	227	9,961
Texas	880,256	34,021	12,482	....	926,759	1,505,383	1.62	242	2,380
Utah	1,301,755	26,354	46,204	307,096	1,681,409	2,026,038	1.20	248	1,925
Virginia	1,623,077	30,153	56,611	1,741,466	3,451,307	3,302,149	.96	267	5,608
Washington	2,978,819	38,541	100,748	75,165	3,193,273	5,380,679	1.69	285	4,768
West Virginia	24,056,649	584,927	473,780	4,221,885	29,337,241	34,297,019	1.17	210	41,554
Wyoming	4,371,611	47,761	193,921	22,000	4,635,293	5,731,281	1.24	252	4,993
Total bituminous	233,050,836	9,758,181	6,138,913	33,801,418	282,749,348	351,687,933	1.24	225	415,777
Pennsylvania anthracite	66,762,592	1,349,736	6,494,740	....	74,607,068	152,036,448	2.04	206	150,483
Grand total	299,813,428	11,107,917	12,633,653	33,801,418	357,356,416	503,724,381	1.41	220	566,260

Coal production of the United States in 1904, by States.

State or Territory.	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	8,195,488	82,087	279,672	2,704,799	11,262,046	$13,480,111	$1.20	216	17,811
Arkansas	1,920,159	33,892	55,400		2,009,451	3,102,660	1.54	165	4,580
California and Alaska	75,328	3,862	392		79,582	377,306	4.74	282	168
Colorado	5,193,932	180,084	187,663	1,096,676	6,658,355	8,751,821	1.31	261	8,123
Georgia and North Carolina	247,844	1,300	8,777	132,270	390,191	476,996	1.22	223	906
Idaho [a]		3,430	50		3,480	13,730	3.95	112	32
Illinois	32,429,921	2,810,152	1,227,320	7,667	36,475,060	39,941,993	1.10	213	54,685
Indiana	9,971,510	653,187	309,682		10,934,379	12,105,709	1.11	177	19,707
Indian Territory	2,823,484	35,512	122,266	65,277	3,046,539	5,532,066	1.82	199	8,487
Iowa	5,662,895	686,290	170,748		6,519,933	10,504,406	1.61	213	15,629
Kansas	5,903,042	310,808	118,983	474	6,333,307	9,640,771	1.52	213	12,198
Kentucky	6,869,247	423,160	180,970	93,105	7,566,482	7,857,691	1.04	197	14,200
Maryland	4,721,714	49,814	42,094		4,813,622	5,729,085	1.19	226	5,671
Michigan	1,270,414	58,009	14,417		1,342,840	2,424,935	1.81	183	3,549
Missouri	3,803,400	274,089	90,819		4,168,308	6,837,886	1.64	206	10,137
Montana	1,138,861	48,418	73,274	98,366	1,358,919	2,194,548	1.61	243	2,505
New Mexico	1,282,201	25,189	41,624	103,311	1,452,325	1,904,499	1.31	228	1,849
North Dakota	180,656	80,685	4,787		266,128	378,032	1.42	191	547
Ohio	22,596,777	1,378,227	416,514	43,294	24,434,812	26,588,476	1.09	175	43,691
Oregon	79,293	13,968	18,279		111,540	243,588	2.18	284	734
Pennsylvania	73,576,949	1,527,586	1,979,364	20,868,368	97,952,267	94,434,219	.96	196	135,125
Tennessee	4,007,889	107,807	63,635	602,880	4,782,211	5,642,393	1.18	217	10,416
Texas	1,159,055	17,596	19,293		1,195,944	1,983,636	1.66	220	2,921
Utah	1,064,177	24,532	54,537	349,781	1,493,027	1,943,440	1.30	294	1,374
Virginia	1,895,840	44,985	66,085	1,577,004	3,583,914	3,076,011	.86	239	5,430
Washington	2,911,612	28,606	120,228	77,235	3,137,681	5,120,931	1.63	243	5,287
West Virginia	28,039,230	609,560	424,627	3,529,402	32,662,819	28,807,420	.88	197	47,485
Wyoming	4,903,257	52,391	216,308	6,600	5,178,556	6,747,909	1.30	262	5,660
Total bituminous	231,924,175	9,565,226	6,307,808	31,356,509	279,153,718	305,842,268	1.10	202	438,907
Pennsylvania anthracite	64,654,440	6,922,282	1,579,987		73,156,709	138,974,020	1.90	200	155,861
Grand total	296,578,615	16,487,508	7,887,795	31,356,509	352,310,427	444,816,288	1.26	202	594,768

[a] Includes production of Nevada.

PRODUCTION IN PREVIOUS YEARS.

In the following table is presented a statement of the quantity and value of the coal produced in the United States during the last 5 years, by States, with the increases and decreases in 1904 as compared with 1903. It will be observed that the comparatively small net decrease was distributed with rather remarkable uniformity throughout the entire country:

Quantity and value of coal produced in the United States, 1900–1904.

State or Territory.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Alabama	8,394,275	$9,793,785	9,099,052	$10,000,892	10,354,570	$12,419,666
Arkansas	1,447,945	1,653,618	1,816,136	2,068,613	1,943,932	2,539,214
California and Alaska	172,908	540,031	152,379	409,706	87,196	273,398
Colorado	5,244,364	5,858,036	5,700,015	6,441,891	7,401,343	8,397,812
Georgia and North Carolina	333,291	393,469	354,825	426,685	437,083	623,518
Idaho	10	50	....	....	2,030	5,180
Illinois	25,767,981	26,927,185	27,331,552	28,163,937	32,939,373	33,945,910
Indiana	6,484,086	6,687,137	6,918,225	7,017,143	9,446,424	10,399,660
Indian Territory	1,922,298	2,788,124	2,421,781	3,915,268	2,820,666	4,265,106
Iowa	5,202,939	7,155,341	5,617,499	7,822,805	5,904,766	8,660,287
Kansas	4,467,870	5,454,691	4,900,528	5,991,599	5,266,065	6,862,787
Kentucky	5,328,964	4,881,577	5,469,986	5,213,076	6,766,984	6,666,967
Maryland	4,024,688	3,927,381	5,113,127	5,046,491	5,271,609	5,579,869
Michigan	849,475	1,259,683	1,241,241	1,753,064	964,718	1,653,192
Missouri	3,540,103	4,280,328	3,802,088	4,707,164	3,890,154	5,374,642
Montana	1,661,775	2,713,707	1,396,081	2,009,316	1,560,823	2,443,447
New Mexico	1,299,299	1,776,170	1,086,546	1,546,652	1,048,763	1,500,230
North Dakota	129,883	158,348	166,601	214,151	226,511	325,967
Ohio	18,988,150	19,292,246	20,943,807	20,928,158	23,519,894	26,953,789
Oregon	58,864	220,001	69,011	173,646	65,648	160,075
Pennsylvania:						
Anthracite	57,367,915	85,757,851	67,471,667	112,504,020	41,373,595	76,173,586
Bituminous	79,842,326	77,438,545	82,305,946	81,397,586	98,574,367	106,032,460
Tennessee	3,509,562	4,003,082	3,633,290	4,067,389	4,382,968	5,399,721
Texas	968,373	1,581,914	1,107,953	1,907,024	901,912	1,477,245
Utah	1,147,027	1,447,750	1,322,614	1,666,082	1,574,521	1,797,454
Virginia	2,393,754	2,123,222	2,725,873	2,353,989	3,182,993	2,543,595
Washington	2,474,093	4,700,068	2,578,217	4,271,076	2,681,214	4,572,295
West Virginia	22,647,207	18,416,871	24,068,402	20,848,184	24,570,826	24,748,658
Wyoming	4,014,602	5,457,953	4,485,374	6,060,462	4,429,491	5,236,339
Total	269,684,027	306,688,164	293,299,816	348,926,069	301,590,439	367,032,069

Quantity and value of coal produced in the United States, 1900–1904—Continued.

State or Territory.	1903.		1904.		Increase or decrease, 1904.		Per cent of increase or decrease, 1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*			
Alabama	11,654,324	$14,246,798	11,262,046	$13,480,111	− 392,278	− $766,687	− 3.4	− 5.4
Arkansas	2,229,172	3,360,831	2,009,451	3,102,660	− 219,721	− 258,171	− 9.9	− 7.7
California and Alaska	105,420	301,318	79,582	377,306	− 25,838	+ 75,988	−24.5	+25.2
Colorado	7,423,602	9,150,943	6,658,355	8,751,821	− 765,247	− 399,122	−10.3	− 4.4
Georgia and North Carolina	434,260	546,759	390,191	476,996	− 44,069	− 69,763	−10.1	−12.8
Idaho[a]	4,250	13,250	3,480	13,730	− 770	+ 480	−18.1	+ 3.6
Illinois	36,957,104	43,196,809	36,475,060	39,941,993	− 482,044	− 3,254,816	− 1.3	− 7.5
Indiana	10,794,692	13,244,817	10,934,379	12,105,709	+ 139,687	− 1,139,108	+ 1.3	− 8.6
Indian Territory	3,517,388	6,386,463	3,046,539	5,532,066	− 470,849	− 854,397	−13.4	−13.4
Iowa	6,419,811	10,563,910	6,519,933	10,504,406	+ 100,122	− 59,504	+ 1.6	− .6
Kansas	5,839,976	8,871,953	6,333,307	9,640,771	+ 493,331	+ 768,818	+ 8.4	+ 8.7
Kentucky	7,538,032	7,979,342	7,566,482	7,857,691	+ 28,450	− 121,651	+ .4	− 1.5
Maryland	4,846,165	7,189,784	4,813,622	5,729,085	− 32,543	− 1,460,699	− .7	−20.3
Michigan	1,367,619	2,707,527	1,342,840	2,424,935	− 24,779	− 282,592	− 1.8	−10.4
Missouri	4,238,586	6,834,297	4,168,308	6,837,886	− 70,278	+ 3,589	− 1.7	+ .1
Montana	1,488,810	2,440,846	1,358,919	2,194,548	− 129,891	− 246,298	− 8.7	−10.1
New Mexico	1,541,781	2,105,785	1,452,325	1,904,499	− 89,456	− 201,286	− 5.8	− 9.6
North Dakota	278,645	418,005	266,128	378,032	− 12,517	− 39,973	− 4.5	− 9.6
Ohio	24,838,103	31,932,327	24,434,812	26,588,476	− 403,291	− 5,343,851	− 1.6	−16.7
Oregon	91,144	221,031	111,540	243,588	+ 20,396	+ 22,557	+22.4	+10.2
Pennsylvania:								
Anthracite	74,607,068	152,036,448	73,156,709	138,974,020	− 1,450,359	−13,062,428	− 1.9	− 8.6
Bituminous	103,117,178	121,752,759	97,952,267	94,434,219	−5,164,911	−27,318,540	− 5.0	−22.4
Tennessee	4,798,004	5,979,830	4,782,211	5,642,393	− 15,793	− 337,437	− .3	− 5.6
Texas	926,759	1,505,383	1,195,944	1,983,636	+ 269,185	+ 478,253	+29.0	+31.8
Utah	1,681,409	2,026,038	1,493,027	1,943,440	− 188,382	− 82,598	−11.2	− 4.1
Virginia	3,451,307	3,302,149	3,583,914	3,076,011	+ 132,607	− 226,138	+ 3.8	− 6.8
Washington	3,193,273	5,380,679	3,137,681	5,120,931	− 55,592	− 259,748	− 1.7	− 4.8
West Virginia	29,337,241	34,297,019	32,602,819	28,807,420	+3,265,578	− 5,489,599	+11.1	−16.0
Wyoming	4,635,293	5,731,281	5,178,556	6,747,909	+ 543,263	+ 1,016,628	+11.7	+17.7
Total	357,356,416	503,724,381	352,310,427	444,816,288	−5,045,989	−58,908,093	− 1.4	−11.7

[a] Includes production of Nevada.

One of the most interesting features connected with the coal-mining industry has been the comparatively rapid growth of bituminous or soft coal production in competition with that of anthracite. This has been particularly noticeable during the last twenty-five years, in all but two of which the statistics of production have been collected by the division of mining and mineral resources of the Geological Survey.

In the following table the statistics for the year 1880 are for the fiscal year, as compiled by the Tenth United States Census. The statistics for the Eleventh Census, which cover the calendar year 1889, and for the Twelfth Census, which cover the calendar year 1902, were collected by this division of the Geological Survey in cooperation with the Census Bureau. The following tables show that while the production of anthracite has increased from 28,649,812 short tons in 1880 to 73,156,709 short tons in 1904—a gain of 44,506,897 short tons, or 155.3 per cent—the bituminous production has grown from 42,831,758 short tons in 1880 to 279,153,718 short tons in 1904, an increase of 236,321,960 short tons, or 551.7 per cent. Although the anthracite production of 1903 and 1904 was considerably above the average for the preceding decade, it does not appear that anthracite mining will exhibit any pronounced increase in the future. The conditions under which the mines are operated and the increase in cost of labor, with the decreasing tendency in the average productive capacity of the mine workers, are making the use of anthracite slowly but surely more and more of a luxury. As the expense of mining, due to the foregoing conditions, has increased, prices have necessarily advanced, and little hope can be held out for any permanent decline in the future. The increased prices of anthracite have naturally encouraged the use of other fuels as a substitute for it, and this tendency is constantly growing.

The use of anthracite coal was at one time an important factor in blast-furnace practice and in other manufacturing industries, but such use has now almost entirely ceased. The principal demand for anthracite at the present time, as will be the case in the future, is for domestic purposes, for which such sizes as furnace, egg, stove, and chestnut are required. The breaking down of the lump coal in the preparation of these domestic sizes results in a much greater proportion of the small, or undersirable, sizes which are sold at less than the cost of production. As shown in the discussion of anthracite production in the subsequent pages of this report, the percentage of the small sizes has increased from 23.1 in 1890 to 38 per cent in 1904, while the percentage of the sizes above pea coal, or what may be termed the profitable sizes, has decreased from 77 to 62 per cent. In other words, the production of the profitable sizes has increased 25 per cent, while the production of the unprofitable sizes has increased 150 per cent. The profits must be obtained from the prepared domestic sizes, and in the face of these conditions no encouragement can be offered to consumers of these grades of anthracite that their fuel bills will be decreased.

During recent years the anthracite operators have adopted the policy of making an allowance of 50 cents per ton from circular prices for domestic coal purchased in April of each year, with an advance of 10 cents per ton for each succeeding month until the schedule prices are restored in September. This has had a more salutary effect in steadying the anthracite trade than any other action taken by those controlling the anthracite industry. Its purpose is to encourage the purchase of coal in the spring and early summer, making the cellars of the consumers the storage places for the following winter, and at the same time causing the mines to be operated more regularly and thus to give more steady employment to employees throughout the year.

Annual production of coal in the United States, 1880–1904.

Year.	Pennsylvania anthracite.			Bituminous coal.		
	Quantity.		Value.	Quantity.		Value.
	Long tons.	*Short tons.*		*Long tons.*	*Short tons.*	
1880	25,580,189	28,649,812	$42,196,678	38,242,641	42,831,758	$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	61,098,154	68,429,933	76,076,487
1883	34,336,469	38,456,845	77,257,055	68,973,821	77,250,680	82,237,800
1884	33,175,756	37,156,847	66,351,512	74,105,986	82,998,704	77,417,066
1885	34,228,548	38,335,974	76,671,948	65,021,715	72,824,321	82,347,648
1886	34,853,077	39,035,446	76,119,120	66,647,304	74,644,981	78,481,056
1887	37,578,747	42,088,197	84,552,181	79,073,495	88,562,314	98,004,656
1888	41,624,611	46,619,564	89,020,483	91,107,226	102,040,093	101,860,529
1889	40,666,938	45,546,970	65,721,578	85,430,842	95,682,543	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	117,901,238	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	148,744,306	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
1904	65,318,490	73,156,709	138,974,020	249,244,391	279,153,718	305,842,268

Annual production of coal in the United States, 1880–1904—Continued.

Year.	Total.		
	Quantity.		Value.
	Long tons.	*Short tons.*	
1880	63,822,830	71,481,570	$100,640,396
1881	76,679,491	85,881,030	124,349,380
1882	92,456,419	103,551,189	146,632,581
1883	103,310,290	115,707,525	159,494,855
1884	107,281,742	120,155,551	143,768,578
1885	99,250,263	111,160,295	159,019,596
1886	101,500,381	113,680,427	154,600,176
1887	116,652,242	130,650,511	182,556,837
1888	132,731,837	148,659,657	190,881,012
1889	126,097,779	141,229,513	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
1904	314,562,881	352,310,427	444,816,288

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, 1889–1904.

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	208,754,746	9,075,756	8,662,864	27,247,826
1900	223,782,088	9,077,242	9,189,746	27,634,951
1901	245,010,812	9,595,308	10,379,546	28,314,150
1902	247,642,852	9,781,996	9,995,861	34,169,730
1903	299,813,128	11,107,917	12,633,653	33,801,418
1904	296,578,615	16,487,508	7,887,795	31,356,509

Distribution of the coal product of the United States, 1889-1904—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
1904	352,310,427	444,816,288	1.26	202	594,768

PRODUCTION IN UNITED STATES FROM EARLIEST TIMES TO CLOSE OF 1904.

Probably the first mention of the occurrence of coal in the United States is contained in the journal of Father Hennepin, a Jesuit missionary who, in 1679, recorded a "cole mine" above Fort Crevecoeur, on the Illinois River, near the site of the present city of Ottawa, in the State of Illinois.[a] This was almost a hundred years before the discovery of coal in Pennsylvania, and about seventy years before the mines in the Richmond basin were opened and worked. Father Hennepin marked the location of this "cole" mine on the map which illustrates his journal.

So far as we know the first coal actually mined in the United States was from the Triassic area in Virginia, in what is commonly known as the Richmond basin. According to Mr. W. J. Nicolls[b] the Virginia mines were opened and worked as early as 1750, and for a number of years not only the citizens of Richmond, but those of Philadelphia and New York obtained their supplies of coal from these mines. But with the discovery of anthracite in Pennsylvania, and the subsequent developments in the Cumberland-Piedmont regions of Maryland and Virginia, and in the Clearfield bituminous districts of Pennsylvania, operations in the Richmond basin fell off and finally ceased to be of any importance. Some few years ago expensive but unsuccessful attempts were made to resume production there on a large scale. But while the coal is well adapted for domestic use, the high cost of mining, due to the depth of the coal and the faulted nature of the beds,

[a] Taylor, R. C.: "Statistics of coal," published in 1848.
[b] Nicolls, W. J.: The story of American coals.

would not admit of its successful competition with other coals even in the Richmond markets, and mining has been practically abandoned.

Ohio probably ranks second in priority of production, one Lewis Evans being said to have discovered coal in the State in 1755, but the first record of actual production in Ohio is eighty-three years later. Anthracite, so called, was discovered in Rhode Island in 1760, but this region, owing to the refractory nature of the coal and the difficulties encountered in mining, has never developed into any importance.

In his report on the anthracite coal field of Pennsylvania, published in the Twenty-second Annual Report of the United States Geological Survey, Part III, Mr. H. H. Stoek, of Scranton, Pa., gives the following sketch of the early history of anthracite coal mining:

The first authentic date in connection with anthracite coal is 1762, when Parshall Terry and a company of Connecticut pioneers found coal at the mouth of Mill Creek, on the banks of the Susquehanna, near the site of the present city of Wilkesbarre. In 1769 Obadiah Core, a blacksmith, used anthracite for fuel in his forge. The presence of coal in the Mahanoy and Shamokin basin of the Schuylkill region was known in 1770, but the beds were not developed until 1834. In 1775 the proprietary government of Pennsylvania had coal floated down the Susquehanna from Wilkesbarre to Harris Ferry (Harrisburg), whence it was hauled by wagon to the arsenal at Carlisle for use in the manufacture of munitions of war. Similar shipments were made annually during the Revolutionary war. In 1788 Jesse Fell used this coal in his nailery.

In 1791 coal was discovered near Mauch Chunk by Philip Ginter, who, according to tradition, on returning home at night kicked a black stone in his path, which proved to be anthracite. The Lehigh Coal Mine Company was formed in 1792, and secured a large tract of coal land, and in 1793 a road was built to the Lehigh River above Mauch Chunk.

Coal was used locally by blacksmiths immediately after each of the above discoveries, and numerous attempts were made to float coal-laden arks down the Lehigh and Susquehanna, but people would not believe that the black stones would burn, and no progress was made for some years in the development of a coal trade.

Oliver Evans burned anthracite in a grate in Philadelphia in 1802. So also did Frederick Groff, chief of the water company in Philadelphia in 1802.

In 1805–6 John and Abijah Smith, from Derby, Conn., settled in Plymouth, Pa., bought coal lands and immediately began shipping coal by arks to points along the lower Susquehanna River. Fifty-five tons were shipped in 1807 to Columbia Pa., and thereafter 400 to 500 tons yearly to points on the lower Susquehanna and to Baltimore, where $10 per ton was received, and to New York, where $12 was the price. It was necessary to create a demand for anthracite coal and to instruct people in its use, so the Smith brothers accompanied their arks and took with them suitable grates, which were set up in public houses to demonstrate the use and value of this fuel.

In 1804 coal was discovered at Carbondale by Samuel Preston; in 1814 William and Maurice Wurtz began its development, and in 1815 they succeeded in sending an ark load to Philadelphia by the Lackawaxen and Delaware rivers, but this experiment was not repeated until 1823.

Reports of the anthracite coal trade are usually begun with the year 1820, when 365 tons of coal were shipped to Philadelphia from the Lehigh region by the Lehigh Coal and Navigation Company, but the dates given above show that the starting point should go back to 1807, and that credit should be given to the Smith brothers of Plymouth, who carried on a successful trade in coal for thirteen years prior to the usual time of beginning the record.

Between 1820 and 1823 the trade from the Lehigh region was firmly established, and about 1825 the Schuylkill region was opened up upon the completion of water communication with Philadelphia by the Schuylkill Navigation Company.

Between 1823 and 1825 the Delaware and Hudson Canal Company was incorporated, and in 1829 began to ship coal from Carbondale by the canal and the gravity railroad.

In the following table, showing the production of coal in the United States from the earliest times, the production of anthracite in Pennsylvania is made to begin in 1814, when the first shipment was made from Carbondale to Philadelphia. An estimated production of 800 tons is distributed through the period between 1814 and 1820. The production from 1807 to 1814 probably amounted to from 2,000 to 2,500 tons.

Although we know that mining began in the Richmond basin in the middle of the eighteenth century, there are no records available from which even an approximate estimate of production can be made for seventy-one years after the mines were opened. The first year for which any figures are given is 1822, when, according to one authority, 54,000 short tons were mined. In 1824 the production is reported to have amounted to 67,040 short tons; in 1826 to 88,720 tons, and in 1828 to 100,280 tons. In each of these years the output exceeded that of Pennsylvania anthracite, but that condition ceased permanently in 1829, although the production of the Richmond basin continued to increase until 1832, when it began to decline. Shortly after the decline began in the Richmond basin the regions in the northwestern part of the State (now West Virginia) began to produce coal, and until 1863, when the State of West Virginia was created, Virginia was numbered among the important coal-producing States. The developments in Tazewell County in 1883 and in Wise County ten years later have again restored Virginia to importance as a coal producer, the State ranking as fifteenth out of thirty-one in 1904.

Notwithstanding the fact that the first mention of coal in the United States is that of Father Hennepin in his notes regarding Illinois, we have no record of any coal being mined there prior to 1810, in which year a flatboat was loaded with coal mined at a point on the Big Muddy River and shipped to New Orleans. Another report states that in 1832 several boat loads were sent from the same locality to the same market. Still another record is found stating that 150,000 bushels, or 6,000 tons, were mined in St. Clair County, Ill., in 1833 and hauled by wagons to St. Louis. It is usually considered, therefore, that coal production in Illinois began in 1833.

Kentucky appears as the third State in priority of coal production. According to one of the early reports of the Kentucky Geological Survey, coal was produced in that State in 1827, but the exact location and the amount of coal mined are not stated. In the same report is the statement to the effect that in 1828 five boat loads of coal were sent from Kentucky mines to Nashville, Tenn., and that from 1829 to 1834 probably from 25 to 35 boat loads of coal were shipped out of Kentucky each year. From the best information available it seems that the production of the State from 1829 to 1835 ranged from 2,000 to 6,000 tons a year, and the United States census for 1840 credits Kentucky with a total production of 23,527 tons.

The next State in priority of actual production, so far as our records go, is Ohio, for in 1838, according to one of the State reports, that State mined 119,952 tons. The census of 1840 contains the earliest mention of coal production in seven different States. It also gives the first mention of Pennsylvania bituminous coal, the output of which for that year is reported at 464,826 short tons. The other States whose first production is reported in 1840 are Missouri, Indiana, Alabama, Tennessee, Iowa, Arkansas, and North Carolina. Shipments from the Cumberland region, in Maryland, began two years later—in 1842—and the records of production for that State are usually dated from that year. Production began in Maryland, however, fully twenty years prior to that date.

Mr. W. J. Nicolls, in his Story of American Coals, states that in 1820 the first shipment of coal from Allegany County, Md., consisted of a few thousand tons, and was sent down the Potomac River in boats. Mr. R. C. Taylor, in his volume, The Statistics of Coal, reports that as early as 1832, 300,000 bushels (equivalent to about 12,000 tons) were annually sent down the Potomac River, but the method of transportation resulted in so much loss of coal and of human life that it was abandoned. The same authority states that the production of bituminous coal in Maryland in 1840 amounted to 222,000 bushels, which was equivalent to 8,800 short tons. It was not until 1860 that any other States entered the lists of coal producers, so far as we have any records. The United States census, which covered the fiscal year 1860, credits the State of Washington with 5,374 short tons; Michigan with 2,320 tons, and Georgia with 1,900 tons. In the following year (1861) California began producing with 6,620 tons, and in 1863 West Virginia was created and is credited with a production of 444,648 tons, and a corresponding decrease was exhibited in the tonnage of Virginia. Colorado is the first of the Rocky Mountain States to be included among the coal producers, a production of 500 tons being reported from that State in 1864. Wyoming began producing in the following year, and Kansas in 1869. Utah's first production was reported by the census of 1870; and that of the Indian Territory, 129,947 short tons, Oregon, 43,205 short tons, and Montana, 224 tons, were reported for the first time by the United States census of 1880.

The New Mexican mines were opened in 1882 with a production of 157,092 tons. Texas and North Dakota began producing in 1884.

Since 1814 the total amount of coal produced in the United States has amounted to 5,600,000,000 short tons, more than 50 per cent of which has been produced in Pennsylvania, the anthracite production having amounted in this period to 1,696,963,748 short tons, and the bituminous production to 1,448,233,213 short tons, or a total for the State of 3,145,196,961 short tons. Illinois ranks second in the amount of total production, with an aggregate of 514,636,696 short tons, and Ohio third, with 407,376,941 short tons. West Virginia, although not created until 1863, ranks fourth, with a total production during forty-two years of 305,221,093 short tons; Maryland ranks fifth, with 131,506,048 short tons; Alabama sixth, with 125,509,824 short tons; Indiana seventh, with 121,559,055 short tons, and Iowa eighth, with 119,969,637 short tons.

Production of coal in the United States from 1814 to the close of 1904.

[Short tons.]

Year.	Pennsylvania.	Virginia.	Kentucky.	Illinois.	Ohio.	Pennsylvania.	Missouri.	Indiana.	Alabama.	Tennessee.	Iowa.	Arkansas.	North Carolina.	Maryland.	Washington.
	Anthracite.					*Bituminous.*									
1814	22														
1815	50														
1816	75														
1817	100														
1818	200														
1819	350														
1820	450														
1821	1,322														
1822	4,583	54,000													
1823	8,563	60,000													
1824	13,685	67,040													
1825	42,988	75,000													
1826	59,194	88,720													
1827	78,151	94,000													
1828	95,500	100,080													
1829	138,086	100,000	2,000												
1830	215,272	102,800	2,000												
1831	217,842	118,000	2,100												
1832	447,550	132,000	2,500												
1833	600,907	125,000	2,750	6,000											
1834	464,015	124,000	5,000	7,500											
1835	690,854	120,000	6,000	8,000											
1836	842,832	124,000	8,000	10,000											
1837	1,071,151	160,000	10,000	12,500											
1838	910,075	300,000	11,500	14,000	119,952										
1839	1,008,322	396,000	16,000	15,038	125,000										
1840	967,108	424,894	23,527	16,967	140,536	464,826	9,972	9,682	946	558	400	220	3		
1841	1,182,441	379,600	35,000	35,000	160,000	475,000	12,000	10,000	1,000	600	500				

1842	1,365,563	373,640	50,000	58,000	225,000	500,000	15,000	18,000	1,000	1,000	750			2,104	
1843	1,556,753	370,000	60,000	75,000	280,000	650,000	25,000	25,000	1,200	4,500	1,000			12,421	
1844	2,009,207	365,000	75,000	120,000	340,000	675,000	35,000	30,000	1,200	10,000	2,500			18,345	
1845	2,480,032	350,000	100,000	150,000	390,000	700,000	50,000	35,000	1,500	18,000	5,000			30,372	
1846	2,887,815	340,000	115,000	165,000	420,000	760,000	68,000	40,000	1,500	25,000	6,500			36,707	
1847	3,551,005	325,000	120,000	180,000	480,000	399,840	80,000	45,000	2,000	30,000	8,000			65,222	
1848	3,805,942	318,000	125,000	200,000	540,000	500,000	85,000	50,000	2,000	40,000	10,000			98,032	
1849	3,995,334	315,000	140,000	260,000	600,000	750,000	90,000	56,000	2,500	52,000	12,500			175,497	
1850	4,138,164	310,000	150,000	300,000	640,000	1,000,000	100,000	60,000	2,500	60,000	15,000			242,517	
1851	5,481,065	310,000	160,000	320,000	670,000	1,200,000	125,000	60,000	3,000	70,000	18,000			317,460	
1852	6,151,957	325,000	175,000	340,000	700,000	1,400,000	140,000	75,000	3,000	75,000	20,000			411,707	
1853	6,400,426	350,000	180,000	375,000	760,000	1,500,000	160,000	75,000	4,000	85,000	23,000			657,862	
1854	7,394,875	370,000	190,000	385,000	800,000	1,650,000	175,000	80,000	4,500	90,000	25,000			812,727	
1855	8,141,754	380,782	200,000	400,000	890,000	1,780,000	185,000	80,000	6,000	100,000	28,000			735,137	
1856	8,534,779	352,687	215,000	410,000	930,000	1,850,000	200,000	85,000	6,800	115,000	30,000			817,659	
1857	8,186,567	363,605	240,000	450,000	975,000	2,000,000	220,000	85,000	8,000	125,000	33,000			654,017	
1858	8,426,102	377,690	250,000	490,000	1,000,000	2,200,000	240,000	87,000	8,500	135,000	37,500			722,686	
1859	9,619,771	359,055	275,000	530,000	1,060,000	2,400,000	260,000	95,000	9,000	150,000	42,000			833,349	
1860	8,115,842	473,360	285,760	728,400	1,265,600	2,690,786	280,000	101,280	10,200	165,300	41,920	200		438,000	5,374
1861	9,799,654	445,165	280,000	670,000	1,150,000	3,200,000	300,000	128,000	10,000	150,000	50,000			287,073	6,000
1862	9,695,110	445,124	275,000	780,000	1,200,000	4,000,000	320,000	150,000	12,500	140,000	53,000		30,000	346,201	7,000
1863	11,785,320	40,000	250,000	890,000	1,204,581	5,000,000	360,000	200,000	15,000	100,000	57,000		30,000	877,313	8,000
1864	12,538,649	40,000	250,000	1,000,000	1,815,622	5,839,000	375,000	250,000	15,000	100,000	63,000		25,000	755,764	10,000
1865	11,891,746	40,000	200,000	1,260,000	1,536,218	6,350,000	420,000	280,000	12,000	100,000	69,574		20,000	1,025,208	12,000
1866	15,651,183	40,000	180,000	1,580,000	1,887,424	6,800,000	450,000	320,000	12,000	100,000	99,320		20,000	1,217,668	13,000
1867	16,002,109	50,000	175,000	1,800,000	2,092,334	7,300,000	500,000	350,000	10,000	110,000	150,000		20,000	1,381,429	14,500
1868	17,003,405	59,051	160,000	2,000,000	2,475,844	7,500,000	541,000	375,000	10,000	125,000	241,453		18,000	1,529,879	15,000
1869	17,083,134	65,000	160,000	1,854,000	2,461,986	6,750,000	550,000	400,000	10,000	130,000	295,105		16,000	2,216,300	16,200
1870	15,664,275	61,803	150,582	2,624,163	2,527,285	7,798,518	621,930	437,870	11,000	133,418	263,487		15,000	1,819,824	17,844
1871	19,342,057	70,000	250,000	3,000,000	4,000,000	9,040,565	725,000	600,000	15,000	180,000	300,000		15,000	2,670,338	20,000
1872	24,233,166	69,440	380,800	3,360,000	5,315,294	11,695,040	784,000	896,000	16,800	224,000	336,000		12,000	2,647,156	23,000
1873	26,152,837	67,200	400,000	3,920,000	4,550,028	13,098,829	784,000	1,000,000	44,800	350,000	392,000		10,000	3,198,911	26,000
1874	24,818,790	70,000	360,000	4,203,000	3,267,585	12,320,000	789,680	812,000	50,400	350,000	799,936			2,899,392	30,352
1875	22,485,766	60,000	500,000	4,453,178	4,864,259	11,760,000	840,000	800,000	67,200	360,000	1,231,547			2,808,018	99,568
1876	22,793,245	55,000	650,000	5,000,000	3,500,000	12,880,000	1,008,000	950,000	112,000	550,000	1,250,000			2,126,873	110,342

Production of coal in the United States from 1814 to the close of 1904—Continued.

Year.	Pennsylvania,	Virginia.	Kentucky.	Illinois.	Ohio.	Pennsylvania.	Missouri.	Indiana.	Alabama.	Tennessee.	Iowa.	Arkansas.	North Carolina.	Maryland.	Washington.
	Anthracite.					*Bituminous.*									
1877......	25,660,316	50,000	850,000	5,350,000	5,250,000	14,000,000	1,008,000	1,000,000	196,000	450,000	1,300,000	....	....	1,939,575	120,896
1878......	21,689,682	50,000	900,000	5,700,000	5,500,000	15,120,000	1,008,000	1,000,000	224,000	375,000	1,350,000	....	....	2,068,925	131,660
1879......	30,207,793	45,000	1,000,000	5,000,000	6,000,000	16,240,000	1,008,000	1,196,490	280,000	450,000	1,400,000	....	....	2,132,233	142,666
1880......	28,649,812	43,079	946,288	6,115,377	6,008,595	18,425,163	844,304	1,454,327	323,972	495,131	1,461,116	14,778	350	2,228,917	145,015
1881......	31,920,018	50,000	1,232,000	6,720,000	9,240,000	22,400,000	1,960,000	1,984,120	420,000	840,000	1,960,000	20,000	300	2,533,348	196,000
1882......	35,121,256	112,000	1,300,000	9,115,653	9,450,000	24,640,000	2,240,000	1,976,470	896,000	850,000	3,920,000	25,000	400	1,555,445	177,340
1883......	38,456,845	252,000	1,650,000	12,123,456	8,229,429	26,880,000	2,520,000	2,560,000	1,568,000	1,000,000	4,457,540	50,000	400	2,476,075	244,990
1884......	37,156,847	336,000	1,550,000	12,208,075	7,640,062	28,000,000	2,800,000	2,260,000	2,240,000	1,200,000	4,370,566	75,000	500	2,765,617	166,936
1885......	38,335,974	567,000	1,600,000	11,834,459	7,816,179	26,000,000	3,080,000	2,375,000	2,492,000	1,440,957	4,012,575	100,000	500	2,833,337	380,250
1886......	39,035,446	684,951	1,550,000	11,175,241	8,435,211	27,094,501	1,800,000	3,000,000	1,800,000	1,714,290	4,315,779	125,000	400	2,517,577	423,525
1887......	42,088,197	825,263	1,933,185	12,423,066	10,300,708	31,516,856	3,209,916	3,217,711	1,950,000	1,900,000	4,473,828	129,600	300	3,278,023	772,601
1888......	46,619,564	1,073,000	2,570,000	14,328,181	10,910,951	33,796,727	3,909,967	3,140,979	2,900,000	1,967,297	4,952,440	276,871	250	3,479,470	1,215,750
1889......	45,546,970	865,786	2,399,755	12,104,272	9,976,787	36,174,089	2,557,823	2,845,057	3,572,983	1,925,689	4,095,358	279,584	222	2,939,715	1,030,578
1890......	46,468,641	784,011	2,701,496	15,292,420	11,494,506	42,302,173	2,735,221	3,305,737	4,090,409	2,169,585	4,021,739	399,888	10,262	3,357,813	1,263,689
1891......	50,665,431	736,399	2,916,069	15,660,698	12,868,683	42,788,490	2,674,606	2,973,474	4,759,781	2,413,678	3,825,495	542,379	20,355	3,820,239	1,056,249
1892......	52,472,504	675,205	3,025,313	17,862,276	13,562,927	46,694,576	2,733,949	3,345,174	5,529,312	2,092,064	3,918,491	535,558	6,679	3,419,962	1,213,427
1893......	53,967,543	820,339	3,007,179	19,949,564	13,253,646	44,070,724	2,897,442	3,791,851	5,136,935	1,902,258	3,972,229	574,763	17,000	3,716,041	1,264,877
1894......	51,921,121	1,229,083	3,111,192	17,113,576	11,909,856	39,912,463	2,245,039	3,423,921	4,397,178	2,180,879	3,967,253	512,626	16,900	3,501,428	1,106,470
1895......	57,999,337	1,368,324	3,357,770	17,735,864	13,355,806	50,217,228	2,372,393	3,995,892	5,693,775	2,535,644	4,156,074	598,322	24,900	3,915,585	1,191,410
1896......	54,346,081	1,254,723	3,333,478	19,786,626	12,875,202	49,557,453	2,331,542	3,905,779	5,748,697	2,663,106	3,954,028	675,374	7,813	4,143,936	1,195,504
1897......	52,611,680	1,528,302	3,602,097	20,072,758	12,196,942	54,417,974	2,665,626	4,151,169	5,893,770	2,888,849	4,611,865	856,190	21,280	4,442,128	1,434,112
1898......	53,382,644	1,815,274	3,887,908	18,599,299	14,516,867	65,165,133	2,688,321	4,920,743	6,535,283	3,022,896	4,618,842	1,205,479	11,495	4,674,884	1,884,571
1899......	60,418,005	2,105,791	4,607,255	24,439,019	16,500,270	74,150,175	3,025,814	6,006,523	7,593,416	3,330,659	5,177,479	843,554	26,896	4,807,396	2,029,881
1900......	57,367,915	2,393,754	5,328,964	25,767,981	18,988,150	79,842,326	3,540,103	6,484,086	8,394,275	3,509,562	5,202,939	1,447,945	17,734	4,024,688	2,474,093
1901......	67,471,667	2,725,873	5,469,986	27,331,552	20,943,807	82,305,946	3,802,088	6,918,225	9,099,052	3,633,290	5,617,499	1,816,136	12,000	5,113,127	2,578,217
1902......	41,373,595	3,182,993	6,766,984	32,939,373	23,519,894	98,574,367	3,890,154	9,446,424	10,354,570	4,382,968	5,904,766	1,943,932	23,000	5,271,609	2,681,214
1903......	74,607,068	3,451,307	7,538,032	36,957,104	24,838,103	103,117,178	4,238,586	10,794,692	11,654,324	4,798,004	6,419,811	2,229,172	17,309	4,846,165	3,193,273
1904......	73,156,709	3,583,914	7,566,482	36,475,060	24,434,812	97,952,267	4,168,308	10,934,379	11,262,046	4,782,211	6,519,933	2,009,451	7,000	4,813,622	3,137,681
	1,696,963,748	44,161,107	93,554,952	514,636,696	407,376,941	1,448,233,213	85,878,784	121,559,055	125,509,824	65,468,393	119,969,637	17,287,022	475,248	131,506,048	33,287,055

Production of coal in the United States from 1814 to the close of 1904.

[Short tons.]

Year.	Michigan.	Georgia.	California.	West Virginia.	Colorado.	Wyoming.	Kansas.	Utah.	Indian Territory.	Oregon.	Montana.	New Mexico.	Texas.	North Dakota.	Miscellaneous.	Total.
1814																22
1815																50
1816																75
1817																100
1818																200
1819																350
1820																450
1821																1,322
1822																58,583
1823																68,563
1824																80,725
1825																117,988
1826																147,914
1827																172,151
1828																195,580
1829																240,086
1830																320,072
1831																337,942
1832																582,050
1833																734,657
1834																600,515
1835																824,854
1836																984,832
1837																1,253,651
1838																1,355,527
1839																1,560,360
1840															1,520	2,061,159
1841																2,291,141
1842																2,610,057
1843																3,060,874
1844																3,[illegible]81,252

Production of coal in the United States from 1814 to the close of 1904—Continued.

Year.	Michigan.	Georgia.	California.	West Virginia.	Colorado.	Wyoming.	Kansas.	Utah.	Indian Territory.	Oregon.	Montana.	New Mexico.	Texas.	North Dakota.	Miscellaneous. a	Total.
1845																4,309,904
1846																4,865,522
1847																5,286,067
1848																5,773,974
1849																6,448,831
1850																7,018,181
1851																8,734,525
1852																9,816,664
1853																10,570,288
1854																11,977,102
1855																12,926,673
1856																13,546,925
1857																13,340,189
1858																13,974,478
1859																15,633,175
1860	2,320	1,900													3,800	14,610,042
1861	3,000	2,500	6,620													16,488,012
1862	5,000	3,500	23,400													17,485,835
1863	8,000	6,000	43,200	444,648												21,319,062
1864	12,000	10,000	50,700	454,888	500											23,605,123
1865	15,000	10,000	60,530	487,897	1,200	800										23,792,173
1866	20,000	8,000	84,020	512,068	6,400	2,500										29,003,583
1867	25,000	8,000	121,690	589,360	17,000	5,000										30,724,422
1868	28,000	10,000	143,676	609,227	10,500	6,925										32,861,960
1869	29,980	12,000	157,234	603,148	8,000	49,382	36,891									32,904,360
1870	28,150	15,000	141,890	608,878	4,500	50,000	32,938	5,800							1,425	33,035,580
1871	32,000	20,000	152,493	618,830	15,600	147,328	41,000								5,629,869	46,885,080
1872	33,600	25,000	190,859	700,000	68,540	221,745	44,800								176,159	51,453,399
1873	56,000	40,000	186,611	1,000,000	69,997	259,700	56,000								1,939,567	57,602,480
1874	58,000	60,000	215,352	1,120,000	77,372	219,061	85,000									52,605,920

1875	62,500	80,000	166,638	1,120,000	98,838	300,808	150,000	....	....	....	....	....	....	....	40,000	52,348,320
1876	66,000	110,000	128,049	896,000	117,666	334,550	225,000	50,400	....	....	....	....	....	....	366,875	53,280,000
1877	69,197	120,000	107,789	1,120,000	160,000	342,853	300,000	50,400	....	....	....	....	....	....	1,056,734	60,501,760
1878	85,322	128,000	134,237	1,120,000	200,630	333,200	375,000	67,200	....	....	....	....	....	....	374,744	57,935,600
1879	82,015	140,000	147,879	1,400,000	322,732	400,991	460,000	50,000	....	....	....	....	....	....	....	68,105,799
1880	100,800	154,644	236,950	1,829,844	462,747	589,595	771,442	14,748	120,947	43,205	224	....	....	....	200	71,481,570
1881	112,000	168,000	140,000	1,680,000	706,744	420,000	840,000	52,000	150,000	33,600	5,000	....	....	....	97,900	85,881,030
1882	135,339	160,000	112,592	2,240,000	1,061,479	707,764	750,000	100,000	200,000	35,000	10,000	157,092	....	....	6,502,359	103,551,189
1883	71,296	155,000	76,162	2,335,833	1,229,593	779,689	900,000	200,000	350,000	40,000	19,795	211,347	....	....	6,870,075	115,707,525
1884	36,712	150,000	77,485	3,360,000	1,130,024	902,620	1,100,000	200,000	425,000	45,000	80,376	220,557	125,000	35,000	9,498,174	120,155,551
1885	45,178	150,000	71,615	3,369,062	1,356,062	807,328	1,212,057	213,120	500,000	50,000	86,440	306,202	100,000	25,000	....	111,160,295
1886	60,434	223,000	100,000	4,005,796	1,368,338	829,355	1,400,000	200,000	534,580	45,000	49,846	271,285	100,000	25,955	794,917	113,680,427
1887	71,461	313,715	50,000	4,881,620	1,791,735	1,170,318	1,596,879	180,021	685,911	37,696	10,202	508,034	75,000	21,470	1,237,195	130,650,511
1888	81,407	180,000	95,000	5,498,800	2,185,477	1,481,540	1,850,000	258,961	761,986	75,000	41,467	626,665	90,000	34,000	4,257,907	148,659,657
1889	67,431	225,934	119,820	6,231,880	2,597,181	1,388,947	2,221,043	236,651	752,832	64,359	363,301	486,943	128,216	28,907	1,400	141,229,513
1890	74,977	228,337	110,711	7,394,654	3,077,003	1,870,366	2,259,922	318,159	869,229	61,514	517,477	375,777	184,440	30,000	807	157,770,963
1891	80,307	171,000	93,301	9,220,665	3,512,632	2,327,841	2,716,705	371,045	1,091,032	51,826	541,861	462,328	172,100	30,000	2,000	168,566,669
1892	77,990	215,498	85,178	9,738,755	3,510,830	2,503,839	3,007,276	361,013	1,192,721	34,661	564,648	661,330	245,690	40,725	1,500	179,329,071
1893	45,979	372,740	72,603	10,708,578	4,102,389	2,439,311	2,652,546	413,205	1,252,110	41,683	892,309	665,094	302,206	49,630	....	182,352,774
1894	70,022	354,111	67,247	11,627,757	2,831,409	2,417,463	3,388,251	431,550	969,606	47,521	927,395	597,196	420,848	42,015	150	170,741,526
1895	112,322	260,998	75,453	11,387,961	3,082,982	2,246,911	2,926,870	471,836	1,211,185	73,685	1,504,193	720,654	484,959	38,997	200	193,117,530
1896	92,882	238,546	78,544	12,876,296	3,112,400	2,229,624	2,884,801	418,627	1,366,646	101,721	1,543,445	622,626	544,015	78,050	18,792	191,986,357
1897	223,592	195,869	87,992	14,248,159	3,361,703	2,597,886	3,054,012	521,560	1,336,380	107,289	1,647,882	716,981	639,341	77,246	18,565	200,229,199
1898	315,722	244,187	145,888	16,700,999	4,076,347	2,863,812	3,406,555	593,709	1,381,466	58,184	1,479,803	992,288	686,734	83,895	17,039	219,976,267
1899	624,708	233,111	160,915	19,252,995	4,776,224	3,837,392	3,852,267	786,049	1,537,427	86,888	1,496,451	1,050,714	883,832	98,809	1,277	253,741,192
1900	849,475	315,557	b 172,908	22,647,207	5,244,364	4,014,602	4,467,870	1,147,027	1,922,298	58,864	1,661,775	1,299,299	968,373	129,883	10	269,684,027
1901	1,241,241	342,825	b 152,379	24,068,402	5,700,015	4,485,374	4,900,528	1,322,614	2,421,781	69,011	1,396,081	1,086,546	1,107,953	166,601	....	293,299,816
1902	964,718	414,083	b 87,196	24,570,826	7,401,343	4,429,491	5,266,065	1,574,521	2,820,666	65,648	c 1,562,853	1,048,763	901,912	226,511	....	301,590,439
1903	1,367,619	416,951	b 105,420	29,337,241	7,423,602	4,635,293	5,839,976	1,681,409	3,517,388	91,144	c 1,493,060	1,541,781	926,759	278,645	....	357,356,416
1904	1,342,840	383,191	b 79,582	32,602,819	6,658,355	5,178,556	6,333,307	1,493,027	3,046,539	111,540	d 1,362,399	1,452,325	1,195,944	266,128	....	352,310,427
	8,987,536	7,077,197	4,920,808	305,221,093	82,940,453	59,829,760	71,405,001	13,784,652	30,417,730	1,530,039	19,258,283	16,081,827	10,283,322	1,807,467	38,911,160	5,578,324,051

a From 1871 to 1888, inclusive, production reported in this column is due principally to colliery consumption, which in some years was estimated and not included in the distribution by States. Since 1888 small, irregular production from several unimportant sources has been included in this column.

b Includes Alaska's production. c Includes Idaho's production. d Production of Idaho and Nevada.

RANK OF COAL-PRODUCING STATES.

In the following tables the coal-producing States are arranged according to rank in 1903 and 1904, first in the amount of coal produced and then according to the value of the product, with the amount and percentage of both quantity and value contributed by each State. In so far as the amount of production is concerned, the first 10 States retain the same relative positions in 1904 as they held in 1903. Wyoming, because of its increased production in 1904, with decreased production in Maryland and Tennessee, advanced from thirteenth to eleventh place, while Maryland dropped from eleventh to twelfth and Tennessee from twelfth to thirteenth. In regard to the value of the product, the first seven States retain their same relative positions, while Kansas displaces Colorado in eighth place and Missouri and Wyoming have both gone ahead of Maryland. The changes among the other States are unimportant.

In this table Pennsylvania is shown to have contributed, with the combined production of anthracite and bituminous coal, a little less than 50 per cent of the entire coal output of the United States. In fact, since 1840, the first year for which any statistics for bituminous coal production in Pennsylvania are obtainable, there have only been three instances in which the proportion of the coal product in this State was less than 50 per cent of the total output of the United States. This was in 1902, when, because of the strike in the anthracite region of Pennsylvania, the production of anthracite in the State decreased 26,000,000 short tons as compared with 1901, and caused the percentage of the State to the total to fall to 46; in 1903, when Pennsylvania produced within 0.2 per cent of one-half the total, and in 1904, when 48.6 per cent was produced in Pennsylvania. Of the other more important coal-producing States, Illinois contributed in 1904 10.4 per cent of the total, West Virginia 9.2 per cent, Ohio 6.9 per cent, Alabama 3.2 per cent, and Indiana 3.1 per cent. These six States each produced more than 10,000,000 short tons in 1904, their combined output being equivalent to 81.4 per cent of the total production.

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	3,360,831	.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	1,505,383	.3
24	Georgia and North Carolina	434,260	.1	24	Georgia and North Carolina	546,759	.1
25	North Dakota	278,645		25	North Dakota	418,005	
26	California and Alaska	105,420	.1	26	California and Alaska	301,318	.2
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

Rank of coal-producing States in 1904, 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	73,156,709	20.8	1	Anthracite	$138,974,020	31.2
	Bituminous	97,952,267	27.8		Bituminous	94,434,219	21.2
2	Illinois	36,475,060	10.4	2	Illinois	39,941,993	9.0
3	West Virginia	32,602,819	9.2	3	West Virginia	28,807,420	6.5
4	Ohio	24,434,812	6.9	4	Ohio	26,588,476	6.0
5	Alabama	11,262,046	3.2	5	Alabama	13,480,111	3.0
6	Indiana	10,934,379	3.1	6	Indiana	12,105,709	2.7
7	Kentucky	7,566,482	2.1	7	Iowa	10,504,406	2.4
8	Colorado	6,658,355	1.9	8	Kansas	9,640,771	2.2
9	Iowa	6,519,933	1.8	9	Colorado	8,751,821	2.0
10	Kansas	6,333,307	1.8	10	Kentucky	7,857,691	1.8
11	Wyoming	5,178,556	1.5	11	Missouri	6,837,886	1.5
12	Maryland	4,813,622	1.4	12	Wyoming	6,747,909	1.5
13	Tennessee	4,782,211	1.4	13	Maryland	5,729,085	1.3
14	Missouri	4,168,308	1.2	14	Tennessee	5,642,393	1.3
15	Virginia	3,583,914	1.0	15	Indian Territory	5,532,066	1.2
16	Washington	3,137,681	.9	16	Washington	5,120,931	1.2
17	Indian Territory	3,046,539	.9	17	Arkansas	3,102,660	.7
18	Arkansas	2,009,451	.6	18	Virginia	3,076,011	7
19	Utah	1,493,027	.4	19	Michigan	2,424,935	.5
20	New Mexico	1,452,325	.4	20	Montana	2,194,548	.5
21	Montana	1,358,919	.4	21	Texas	1,983,636	.5
22	Michigan	1,342,840	.4	22	Utah	1,943,440	.4
23	Texas	1,195,944	.3	23	New Mexico	1,904,499	.4
24	Georgia and North Carolina	390,191	.1	24	Georgia and North Carolina	476,996	.1
25	North Dakota	266,128		25	North Dakota	378,032	
26	Oregon	111,540		26	California and Alaska	377,306	.2
27	California and Alaska	79,582	.1	27	Oregon	243,588	
28	Idaho	a3,480		28	Idaho	a13,730	
	Total	352,310,427	100.0		Total	444,816,288	100.0

a Includes production of Nevada.

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 varieties of coal in 1903 and 1904 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 48,245 short tons mined in Colorado in 1904, and that 23,829 short tons were produced in New Mexico. Semianthracite coal is produced in Pennsylvania, Colorado, Tennessee, Indian Territory, Virginia, and Arkansas; the latter State being credited with 726,089 short tons out of a total of 1,133,689 tons in 1904. Bituminous coal was produced in 27 States and Territories, the first 7 States in the total production leading also in the production of bituminous coal. Semibituminous coal was produced in 14 States and Territories, with West Virginia first, Pennsylvania second, Maryland third, Virginia fourth, and Colorado fifth. The small production from Alaska in 1904 was reported as semibituminous and lignite. Wyoming leads in the production of lignite, nearly 60 per cent of the total of this variety being from that State. Colorado ranks second in the production of lignite, with Texas third and New Mexico fourth. West Virginia is credited with nearly the entire product of splint coal, and nearly 90 per cent of the block coal is from Indiana. The comparatively small production of cannel coal was distributed among 8 States, of which West Virginia and Kentucky are the principal producers.

Classification of the coal product of the United States in 1903, by States and Territories.

[Short tons.]

State or Territory.	Bituminous.	Anthracite.	Semibituminous.	Lignite.	Semi-anthracite.	Block.	Splint.	Cannel.	Total.
Pennsylvania	99,734,819	74,607,068	3,332,564		48,641			1,154	177,724,246
Illinois	36,855,262		94,746			7,096			36,957,104
West Virginia	22,321,486		4,532,454				2,347,238	a 136,063	29,337,241
Ohio	24,803,084					8,979	26,040		24,838,103
Alabama	11,600,436		53,888						11,654,324
Indiana	9,569,953		9,794			b 1,179,045		35,900	10,794,692
Kentucky	7,359,994					35,032	5,000	c 138,006	7,538,032
Colorado	5,931,394	42,139	298,153	1,107,513	44,403				7,423,602
Iowa	6,341,487					58,703		19,621	6,419,811
Kansas	5,809,828		4,281	1,017		24,850			5,839,976
Maryland	2,982,533		1,863,632						4,846,165
Tennessee	4,749,587				48,417				4,798,004
Wyoming	1,257,917		261,058	3,116,318					4,635,293
Missouri	4,237,886							700	4,238,586
Indian Territory	3,271,293				246,095				3,517,388
Virginia	2,657,709		764,055		29,543				3,451,307
Washington	2,727,245		7,107	458,921					3,193,273
Arkansas	1,096,932		27,204	3,000	1,102,036				2,229,172
Utah	1,680,681		728						1,681,409
New Mexico	940,067	30,592	1,760	569,362					1,541,781
Montana	1,480,285			7,875				650	1,488,810
Michigan	1,331,570					36,049			1,367,619
Texas	659,154			267,605					926,759
Georgia	416,951								416,951
North Dakota	28,315			250,330					278,645
California	1,000		2,600	101,073					104,673
Oregon			560	a 90,584					91,144
North Carolina	17,309								17,309
Idaho	500			3,750					4,250
Alaska	700			47					747
Total	259,865,377	74,679,799	11,254,584	5,977,395	1,519,135	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.

Classification of the coal product of the United States in 1904, by States and Territories.

[Short tons.]

State or Territory.	Bituminous.	Anthracite.	Semibituminous.	Lignite.	Semi-anthracite.	Block.	Splint.	Cannel.	Total.
Pennsylvania	95,726,493	73,156,709	2,194,614		25,353			5,807	171,108,976
Illinois	36,389,276		83,278			2,506			36,475,060
West Virginia	24,988,932		5,395,364			107,373	1,921,446	c 189,704	32,602,819
Ohio	24,413,498					4,876	7,850	8,588	24,434,812
Alabama	a 11,255,566					6,480			11,262,046
Indiana	9,771,276					d 1,130,753		32,350	10,934,379
Kentucky	7,384,197		37,000			e 5,000	7,882	f 132,403	7,566,482
Colorado	4,959,680	48,245	468,572	1,173,503	8,355				6,658,355
Iowa	6,461,372					45,434		13,127	6,519,933
Kansas	6,331,807			1,500					6,333,307
Wyoming	1,261,216		233,585	3,683,005	350				5,178,556
Maryland	3,386,122		1,427,500						4,813,622
Tennessee	4,612,308		129,603		28,100	12,200			4,782,211
Missouri	4,023,201		64,071			73,515		7,521	4,168,308
Virginia	2,740,831		811,422		31,661				3,583,914
Washington	2,742,179		150,112	245,390					3,137,681
Indian Territory	2,734,864				311,675				3,046,539
Arkansas	1,266,362		17,000		726,089				2,009,451
Utah	1,491,053		868		1,106				1,493,027
New Mexico	1,009,526	23,829		418,970					1,452,325
Montana	1,331,383			25,836	1,000			700	1,358,919
Michigan	1,342,840								1,342,840
Texas	774,315			421,629					1,195,944
Georgia	383,191								383,191
North Dakota	16,610			249,518					266,128
Oregon				111,540					111,540
California				78,888					78,888
North Carolina	7,000								7,000
Idaho b	1,230			2,250					3,480
Alaska			224	470					694
Total	256,806,728	73,228,783	11,013,213	6,412,499	1,133,689	1,388,137	1,937,178	390,200	352,310,427

a Includes 6,455 tons of semicannel coal.
b Includes Nevada's production.
c Includes 166,904 tons of semicannel coal.
d Includes 264,731 tons of semiblock coal.
e Includes 3,500 tons of semiblock coal.
f Includes 51,811 tons of semicannel coal.

LABOR STATISTICS.

In the table on page 419 is shown the number of men employed and the average number of days made by each during the last five years, by States. It will be observed that notwithstanding the decreased production in 1904 there was a general increase in the number of men employed, accompanied by a decrease in the average number of days the mines were worked. The total number of men employed in the bituminous mines increased from 415,777, in 1903, to 438,907, in 1904, while the average number of days worked decreased from 225 to 202. The number of employees in the anthracite region of Pennsylvania increased from 150,483 to 155,861, with a decrease in the average number of working days from 206 to 200.

By the terms of the award of the Anthracite Coal Strike Commission, which is to continue in force until March 31, 1906, 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 pumpmen, who were allotted 8 hours for a day's work. No number of hours was prescribed for the miners themselves, for the reason that in the anthracite region, as in the bituminous regions, practically all of the coal is mined by contract at so much per ton, bushel, or mine car, by yardage, or by other basis of measurement of the coal mined.

In order that some idea might be obtained as to the number of working hours prevalent among the bituminous coal-producing States, of the inquiries of the Survey during the last two or three years one was for the number of hours of the day worked. Replies to these inquiries have been made by the mines employing an aggregate of 384,732 men out of a total in the United States of 415,777 in 1903, and by mines employing an aggregate of 424,258 men out of a total in the United States of 438,907 in 1904. They are sufficient, therefore, for practical purposes and to make comparisons for the two years. The results have been compiled and are shown in the tables on pages 421, 422. They show that considerably more than half of the men reported in both years worked on a basis of 8 hours a day. Two thousand six hundred and sixty-seven mines, employing 214,968 men, in 1903 reported 8 hours to the working day, while 3,014 mines, employing 262,591 men, reported an 8-hour day in 1904. Nine hours were reported for 582 mines, employing 65,409 men, in 1903, and for 646 mines, employing 58,061 men, in 1904. A difference of only 0.8 of 1 per cent is shown in the number of men working 10 hours in the two years. In 1903, 101,189 men, employed at 794 mines, and in 1904, 101,986 men, employed at 913 mines, were reported as working 10 hours.

Statistics of labor employed in coal mines of the United States, 1900–1904, by States.

State or Territory.	1900.		1901.		1902.		1903.		1904.	
	Number of days active.	Average number employed.	Number of days active.	Average number employed.	Number of days active.	Average number employed.	Number of days active.	Average number employed.	Number of days active.	Average number employed.
Alabama	257	13,967	236	17,370	256	16,439	228	21,438	216	17,811
Arkansas	219	2,800	223	3,144	188	3,595	223	4,157	165	4,580
California	309	378	289	428	a 302	a 217	a 301	a 208	a 282	a 168
Colorado	264	7,459	253	8,870	261	8,956	245	9,229	261	8,123
Georgia	b 262	b 681	b 291	b 791	b 312	b 795	b 296	b 730	b 223	b 906
Idaho	....	....	....	....	74	20	197	32	c 112	c 32
Illinois	226	39,101	220	41,880	226	47,411	228	50,596	213	54,685
Indiana	199	11,720	194	12,968	205	15,457	197	17,017	177	19,707
Indian Territory	228	4,525	208	6,706	232	5,574	247	7,704	199	8,487
Iowa	228	11,608	218	12,653	227	12,434	226	14,162	213	15,629
Kansas	232	8,459	224	9,928	220	9,461	215	10,924	213	12,198
Kentucky	227	9,680	213	10,307	209	13,727	207	14,354	197	14,200
Maryland	203	5,319	262	5,333	242	5,827	219	5,859	226	5,671
Michigan	261	1,709	247	2,276	171	2,344	222	2,768	183	3,549
Missouri	214	8,180	223	9,871	202	9,742	215	9,544	206	10,137
Montana	252	2,376	231	2,158	270	1,938	254	2,155	243	2,505
New Mexico	261	2,037	224	2,478	217	1,849	260	1,789	228	1,849
North Dakota	142	326	198	280	213	402	198	486	191	547
Ohio	215	27,628	198	32,111	200	38,965	194	41,936	175	43,691
Oregon	273	141	228	187	234	265	258	235	284	734
Pennsylvania bituminous	242	92,692	230	101,904	248	112,630	235	129,265	196	135,125
Tennessee	242	7,646	228	9,046	230	8,750	227	9,961	217	10,416
Texas	246	2,844	264	3,051	267	2,369	242	2,380	220	2,921
Utah	246	1,308	259	1,712	259	1,826	248	1,925	294	1,374
Virginia	239	3,631	279	4,152	293	3,912	267	5,608	239	5,430
Washington	289	3,670	276	4,545	275	4,404	285	4,768	243	5,287
West Virginia	231	29,163	219	30,935	205	35,500	210	41,554	197	47,485
Wyoming	266	5,332	248	5,151	248	5,250	252	4,993	262	5,660
Total	234	304,380	225	340,235	230	370,059	225	415,777	202	438,907
Pennsylvania anthracite	166	144,206	196	145,309	116	148,141	206	150,483	200	155,861
Grand total	212	448,581	216	485,544	197	518,200	220	566,260	202	594,768

a Includes Alaska.

b Includes North Carolina.

c Includes Nevada.

It will further be observed that in States in which the miners are more thoroughly organized 8 hours to the working day is the general rule, it being noted that in Pennsylvania, Ohio, Michigan, and in Illinois, and the other States of the Mississippi Valley, most of the mines are worked on an 8-hour basis, while in West Virginia, Virginia, Alabama, Kentucky, and in Maryland, where the miners are not so thoroughly organized, the mines are worked, as a general thing, on a 9 or 10 hour basis. In some instances the miners and other men employed inside the mines work on a basis of an 8-hour day, while the outside men work 9 and sometimes 10 hours. It is somewhat difficult to state from the returns made to the Survey what influence has been exerted on the productive capacity of each employee by the number of hours to the working day, as the mining conditions in the different States vary so markedly, and there are so many other influences, particularly the use of mining machines, which enter into the question. Attention may be called, however, to the fact that Illinois, in which nearly all of the men work 8 hours, shows a decrease in the average tonnage per man for the year from 731 in 1903 to 667 in 1904, and the average daily tonnage per man from 3.21 in 1903 to 3.13 in 1904. Among other strong 8-hour States and Territories are Iowa, where the average yearly tonnage per man decreased from 453.3 in 1903 to 417.2 in 1904, and the average daily tonnage per man from 2 in 1903 to 1.96 in 1904; Kansas, where the average yearly tonnage per man declined from 534.6 in 1903 to 519.2 in 1904, and the average daily tonnage per man from 2.49 to 2.44; Missouri, where the average yearly tonnage per man decreased from 444.1 in 1903 to 411.2 in 1904, and the average daily tonnage per man from 2.07 to 2; Indian Territory, where the average yearly tonnage decreased from 457 in 1903 to 359.9 in 1904, and the average daily tonnage per man from 1.85 to 1.80. On the other hand, in the States which work 9 or 10 hours, Alabama shows that the average yearly tonnage per man increased from 543.6 in 1903 to 632.3 in 1904, while the average daily tonnage increased from 2.38 in 1903 to 2.93 in 1904. Kentucky's average yearly tonnage per man increased from 525.2 in 1903 to 532.9 in 1904, while the average daily tonnage per man increased from 2.54 to 2.71; Virginia, whose average yearly tonnage per man increased from 615 in 1903 to 660 in 1904, and average daily tonnage per man increased from 2.3 in 1903 to 2.76 in 1904.

In order to upset, however, whatever might be deduced from these figures, it is shown that in Arkansas, where the men were employed upon an 8-hour basis, the average yearly tonnage decreased from 536.2 in 1903 to 438.7 in 1904, while the average daily tonnage per man increased from 2.4 in 1903 to 2.66 in 1904. Ohio, which is also a strong 8-hour State, shows a decrease in the average yearly tonnage of 592 in 1903 to 559.3 in 1904, while the average daily tonnage increased from 3.05 per man in 1903 to 3.2 in 1904. A similar condition is exhibited in Pennsylvania, whose average yearly tonnage per man decreased from 798 in 1903 to 724.9 in 1904, while the average daily tonnage per man increased from 3.4 in 1903 to 3.7 in 1904; and West Virginia, most of whose mines are worked upon a 10-hour basis and comparatively few on the 8-hour basis, shows a reduction from 706 in the average yearly tonnage per man in 1903 to 686.6 in 1904, while the average daily tonnage increased from 3.36 in 1903 to 3.49. From the statistics here presented it is not possible to state what effect the shorter hours have had upon the intensity of labor among the mine workers.

Number of hours to the working day in 1903, by States.

State or Territory.	Less than eight hours.		Eight hours.		Nine hours.		Ten hours.		More than ten hours.	
	Mines.	Men.	Mines.	Men.	Mines.	Men.	Mines.	Men.	Mines.	Men.
Alabama			20	935	34	7,665	61	10,746		
Arkansas			38	4,029			2	14		
California			1	15	2	57	3	129		
Colorado	1	8	24	488	17	692	70	7,743		
Georgia							3	605		
Idaho			1	20	1	10				
Illinois	23	168	542	47,773	11	57	9	45		
Indiana	7	41	236	16,291	5	24	6	39		
Indian Territory			55	6,952	3	487	2	190		
Iowa	4	36	237	12,689	3	27				
Kansas	4	144	145	9,965	9	447	8	62		
Kentucky	3	55	49	3,372	42	3,779	81	6,157		
Maryland			1	45			29	3,808		
Michigan	7	353	9	1,233						
Missouri	3	30	191	9,119	8	51	7	52		
Montana			13	449	5	1,635	1	3		
New Mexico			7	99	1	3	13	1,309		
North Carolina[a]										
North Dakota			6	40	8	90	20	263	2	13
Ohio	17	179	538	39,876	15	455	14	206		
Oregon			3	13	1	4	1	133		
Pennsylvania	9	1,072	481	58,761	220	28,221	170	32,192		
Tennessee	4	608	1	9	54	5,614	23	3,415		
Texas			3	71	6	1,185	6	573		
Utah			12	158	4	1,747	3	9	1	3
Virginia			2	250	4	21	21	5,032		
Washington			5	342	17	2,244	6	2,180		
West Virginia	7	456	45	1,685	110	10,311	212	22,260		
Wyoming			2	289	2	583	20	4,024		
Total	89	3,150	2,667	214,968	582	65,409	794	101,189	3	16

[a] Included in Georgia.

Number of hours to the working day in 1904, by States.

State or Territory.	Less than eight hours.		Eight hours.		Nine hours.		Ten hours.		More than t hours.	
	Mines.	Men.	Mines.	Men.	Mines.	Men.	Mines.	Men.	Mines.	Me
Alabama	....	....	17	876	50	5,763	50	8,409	....	....
Alaska[a]	....	....	....	....	....	....	....	....	....	....
Arkansas	1	7	42	4,472	....	....	....	....	....	....
California	....	....	....	....	2	22	4	146	....	....
Colorado	....	....	55	2,058	11	432	57	5,583	....	....
Georgia	....	....	1	100	....	....	3	806	....	....
Idaho	....	....	....	....	2	25	1	3	....	....
Illinois	15	210	547	53,500	17	121	10	52	....	....
Indiana	7	36	244	18,727	7	44	4	16	1	9
Indian Territory	....	....	59	8,251	2	95	2	75	....	....
Iowa	4	25	261	15,221	1	10	1	10	....	....
Kansas	1	14	151	11,599	9	215	5	45	....	....
Kentucky	5	99	58	3,870	60	4,208	141	5,952	....	....
Maryland	....	....	2	72	6	974	43	4,531	....	....
Michigan	7	393	20	2,627	....	....	....	....	....	....
Missouri	5	28	198	9,686	10	72	8	65	....	....
Montana	....	....	19	646	8	1,653	4	12	....	....
New Mexico	1	60	6	78	1	31	15	1,680	....	....
North Carolina[b]	....	....	....	....	....	....	....	....	....	....
North Dakota	....	....	8	66	11	117	20	292	1	14
Ohio	14	182	574	42,845	9	296	7	77	....	....
Oregon	....	....	1	3	2	25	2	156	....	....
Pennsylvania	7	140	637	77,960	223	24,972	187	30,286	....	....
Tennessee	2	153	8	657	63	6,102	24	2,887	....	....
Texas	2	95	7	1,624	2	91	12	971	....	....
Utah	....	....	15	1,356	2	5	1	2	....	....
Virginia	....	....	2	256	6	372	24	4,092	....	....
Washington	....	....	[c]24	4,152	4	70	....	....	....	....
West Virginia	3	151	53	1,870	137	11,855	271	30,751	....	....
Wyoming	....	....	5	19	1	491	17	5,087	1	4
Total	74	1,593	3,014	262,591	646	58,061	913	101,986	3	27

[a] Included in California.
[b] Included in Georgia.
[c] Includes a number of mines in which the miners and other inside men worked 8 hours, but where the outside men worked 10 hours, no separation being made.

In the following table is shown the average number of men employed in the anthracite and the bituminous mines of the United States, and the average number of days worked by each, from 1890 to 1904, inclusive. It is to be observed that while the number of men employed in the anthracite region during this period has increased less than 25 per cent, the number of men employed in the bituminous mines in 1904 is more than two and one-fourth times those employed in 1890.

Statistics of labor employed in coal mines of the United States, 1890–1904, 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
1904	200	155,861	202	438,907

From the statistics contained in the preceding table, and the totals of production in the earlier pages of this report, the following statement has been prepared showing the average annual and daily tonnage per man from 1890 to 1904. This table shows that in 1890 the average annual production per man employed in the anthracite region of Pennsylvania was 369 short tons, while the average daily tonnage per man was 1.85 tons. In the production of bituminous and lignite coals the average yearly tonnage per man in 1890 was 579 short tons, and the average daily tonnage per man was 2.56 tons. In 1904 the average production per man in the anthracite region was 469 short tons for the year, and 2.35 tons for the day, while the bituminous production shows an average of 636 tons per man for the year and 3.15 tons per man per day. The largest tonnage per man for any year in the anthracite region was in 1903 when the men produced 496 short tons, working an average of 206 days in the year and producing 2.41 short tons per day. The highest average daily tonnage in the anthracite region per man was made in 1899, when each employee was credited with a production of 2.5 tons, but on account of the small number of days in the year (173) the average production per man amounted to but 433 tons. The highest yearly average per man in the bituminous regions was 713 tons, made in 1899, while the best average daily tonnage was that made in 1904.

Production of coal according to number of persons employed, 1890–1904.

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
1904	155,861	200	2.35	469	438,907	202	3.15	636

COAL MINED BY MACHINES.

The use of mining machines in the production of bituminous coal continues to show an increasing tendency, although the developments in 1904 were shown rather in the number of machines installed than in any increase in the total production of coal by machines. The total amount of coal produced by the use of machines in 1904 was 78,692,497 short tons, as compared with 77,974,894 short tons in 1903, indicating an increase of 717,603 tons, or 0.92 per cent. Considering the fact that the total number of machines in use increased from 6,658 to 7,671, an increase of 1,013, or 15.2 per cent, the increase in the amount of machine-mined tonnage appears small, but when considered in connection with the fact that the total bituminous production decreased from 282,749,348 tons in 1903 to 279,153,718 tons in 1904, the increase in the amount produced by machines is significant. Moreover, a large number of machines which were reported as in use in 1904 were not installed until late in the year. The percentage of the machine-mined tonnage to the total production in the States in which machines have been installed has increased steadily each year. In 1899 this percentage was 23; in 1900 it was 25.15; in 1901, 25.68; in 1902, 27.09; in 1903, 28.18, and in 1904, 28.78.

One interesting fact brought out by the statistics in the following tables is the decrease in the average production for each machine employed. In 1899 there were 3,125 machines in use, the average production for each machine being 14,068 tons. In 1900 there were 3,907 machines in use, with a total production each of 13,510 tons. In

1901 the number of machines had increased to 4,341, while the average production for each machine had decreased to 13,325 short tons. In 1902 the number of machines had increased to 5,418, while the average production for each machine had decreased to 12,848 tons. In 1903, 6,658 machines were reported, with an average tonnage each of 11,712, while in 1904 the 7,671 machines averaged 10,258 short tons. Of the 7,671 machines in use in 1904, 4,491 were of the pick, or puncher, type; 3,102 were of the chain-breast pattern, and 78 were long-wall machines. Nearly 50 per cent of the total number of machines in use and also of the machine-mined product was reported from Pennsylvania, the number of machines in use in this State being 3,645 in 1904, and the machine-mined product 35,174,613 tons.

West Virginia comes second in the number of machines in use, with a total of 901 and a machine-mined production of 9,526,749 tons. Ohio is third in the total number of machines employed, but outranks West Virginia by almost exactly 50 per cent in the tonnage undercut by them. Ohio reported in 1904 a total of 867 machines, and a machine-mined product of 14,001,647 tons. Illinois reported 643 machines in use, and 7,110,902 short tons as machine mined. Kentucky, with 453 machines in use, reported 3,595,513 short tons of machine-mined coal; Indiana, with 409 machines, reported 3,681,032 tons produced by them. Of these six States, Ohio leads in the percentage of coal undercut by machines, considerably more than half, or 57.30 per cent, of the State's total being machine mined; Kentucky ranks second in percentage, with 47.52 per cent of the total production in 1904 undercut by machines; Pennsylvania comes third, with 35.91 per cent; Indiana fourth, with 33.66 per cent; West Virginia fifth, with 29.22 per cent, and Illinois last, with 19.50 per cent. The proportion of Illinois's machine-mined production to the total has fallen from 25 per cent in 1899 to 19.5 in 1904. To the opposition on the part of the mine workers' organization of Illinois to the introduction and use of mining machines has been ascribed the decreased production of machine-mined coal in 1904 as compared with the two preceding years.

The statistics in regard to the coal mined by machines during the last five years are shown in the following table, together with the number of machines used 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 of those States.

Bituminous coal mined by machines in the United States in 1900, 1901, 1902, 1903, and 1904.

State or Territory.	Number of machines in use.					Number of tons mined by machines.				
	1900.	1901.	1902.	1903.	1904.	1900.	1901.	1902.	1903.	1904.
Alabama	54	82	66	98	141	370,150	289,051	300,670	577,317	741,170
Arkansas	20	20	7	....	....	219,085	102,220	8,989	....	....
Colorado	90	62	98	157	125	756,025	319,678	857,279	1,270,221	945,965
Illinois	430	464	508	553	643	5,083,594	5,774,639	7,112,039	7,381,027	7,110,902
Indiana	254	256	269	329	409	1,774,045	1,852,058	2,421,342	3,334,961	3,681,032
Indian Territory	58	47	23	36	18	239,424	177,233	119,195	73,304	42,594
owa	40	53	31	10	39	132,757	110,980	110,489	55,085	175,742
Kansas	3	4	6	5	5	46,164	37,979	48,000	9,876	10,600
Kentucky	239	237	318	308	453	2,339,944	2,254,711	3,091,626	2,843,805	3,595,513
Maryland	10	15	25	36	38	138,014	177,724	252,753	401,144	484,373
Michigan	33	31	58	46	85	191,577	177,969	196,248	180,943	310,007
Missouri	15	24	20	33	31	110,036	153,879	223,969	311,602	376,505
Montana	81	70	65	63	57	1,045,115	748,981	691,669	693,504	482,924
New Mexico	21	6	17	12	12	112,000	2,700	71,744	105,000	100,000
North Dakota	7	7	10	9	9	33,965	43,574	89,838	115,222	125,097
Ohio	341	376	559	724	867	8,835,743	9,908,316	12,094,641	14,007,326	14,001,647
Pennsylvania	1,786	2,058	2,620	3,310	3,645	26,867,053	29,591,368	35,058,038	37,146,253	35,174,613
Tennessee	18	21	38	51	85	176,872	220,573	303,995	304,602	440,618
Texas	....	8	8	8	9	....	22,420	25,500	29,000	33,154
Utah	....	13	13	13	9	....	14,738	74,502	75,000	34,054
Virginia	9	6	11	10	18	231,269	233,275	132,709	82,040	245,536
Washington	2	4	....	....	....	10,000	6,500	....	....	....
West Virginia	327	403	579	788	901	3,418,377	4,817,943	5,738,045	8,193,840	9,526,749
Wyoming	69	74	69	59	72	653,314	804,826	588,302	783,822	1,053,702
Total	3,907	4,341	5,418	6,658	7,671	52,784,523	57,843,335	69,611,582	77,974,894	78,692,497

Bituminous coal mined by machines in the United States in 1900, etc.—Continued.

State or Territory.	Total tonnage of States using mining machinery.					Percentage of total product mined by machines.				
	1900.	1901.	1902.	1903.	1904.	1900.	1901.	1902.	1903.	1904.
Alabama	8,394,275	9,099,052	10,354,570	11,654,324	11,262,046	4.41	3.17	2.90	4.95	6.58
Arkansas	1,477,945	1,816,136	1,943,932	....	....	14.82	5.62	.46	....	....
Colorado	5,244,364	5,700,015	7,401,343	7,423,602	6,658,355	14.42	5.60	11.58	17.11	14.21
Illinois	25,767,981	27,331,552	32,939,373	36,957,104	36,475,060	19.73	21.12	21.59	19.97	19.50
Indiana	6,484,086	6,918,225	9,446,424	10,794,692	10,934,379	27.36	26.77	25.63	30.90	33.66
Indian Territory	1,922,298	2,421,781	2,820,666	3,517,388	3,046,539	12.46	7.31	4.23	2.08	1.40
Iowa	5,202,939	5,617,499	5,904,766	6,419,811	6,519,933	2.55	1.97	1.87	.86	2.70
Kansas	4,467,870	4,900,528	5,266,065	5,839,976	6,333,307	1.03	.77	.91	.17	.17
Kentucky	5,328,964	5,469,986	6,766,984	7,538,032	7,566,482	43.91	41.21	45.69	37.73	47.52
Maryland	4,024,688	5,113,127	5,271,609	4,846,165	4,813,622	3.43	3.47	4.28	8.28	10.06
Michigan	849,475	1,241,241	964,718	1,367,619	1,342,840	22.55	14.33	20.34	13.23	23.09
Missouri	3,540,103	3,802,088	3,890,154	4,238,586	4,168,308	3.11	4.04	5.76	7.35	9.03
Montana	1,661,775	1,396,081	1,560,823	1,488,810	1,358,919	62.89	53.64	44.31	46.58	35.54
New Mexico	1,299,299	1,086,546	1,048,763	1,541,781	1,452,325	8.62	.24	6.84	9.40	6.89
North Dakota	129,883	166,601	226,511	278,645	266,128	26.15	26.15	39.66	41.35	47.01
Ohio	18,988,150	20,943,807	23,519,894	24,838,103	24,434,812	46.53	47.26	51.42	56.39	57.30
Pennsylvania	79,842,326	82,305,946	98,574,367	103,117,178	97,952,267	33.65	35.95	35.57	36.02	35.91
Tennessee	3,708,562	3,633,290	4,382,968	4,798,004	4,782,211	4.77	6.07	6.94	6.35	9.21
Texas	....	1,107,953	901,912	926,759	1,195,944	....	2.02	2.83	3.13	2.77
Utah	....	1,322,614	1,574,521	1,681,409	1,493,027	....	1.11	4.81	4.46	2.28
Virginia	2,393,754	2,725,873	3,182,993	3,451,307	3,583,914	9.66	8.55	4.17	2.38	6.85
Washington	2,474,093	2,578,217	....	....	....	.40	.25	....	....	....
West Virginia	22,647,207	24,068,402	24,570,826	29,337,241	32,602,819	15.09	20.01	23.35	27.93	29.22
Wyoming	4,014,602	4,485,374	4,429,491	4,635,293	5,178,556	16.27	17.94	13.10	16.91	20.35
Total	209,864,639	225,251,934	256,943,673	276,691,829	273,421,793	a 25.15	a 25.68	a 27.09	a 28.18	a 28.78

a Average.

In the following table are shown the number and kinds of machines in use in each State in 1903 and 1904:

Number and kinds of machines in use in 1903 and 1904.

State or Territory.	1903.				1904.			
	Pick.	Chain-breast.	Long-wall.	Total.	Pick.	Chain-breast.	Long-wall.	Total.
Alabama	89	9		98	119	22		141
Colorado	88	65	4	157	67	56	2	125
Illinois	451	100	2	553	541	102		643
Indiana	110	219		329	139	269	1	409
Indian Territory	16	18	2	36	8	10		18
Iowa			10	10	11	10	18	39
Kansas		3	2	5	3		2	5
Kentucky	202	105	1	308	336	112	5	453
Maryland	36			36	38			38
Michigan	46			46	84	1		85
Missouri	4		29	33		1	30	31
Montana	61	2		63	56	1		57
New Mexico		12		12	2	10		12
North Dakota	2	7		9	1	8		9
Ohio	51	673		724	88	779		867
Pennsylvania	2,267	1,039	4	3,310	2,455	1,175	15	3,645
Tennessee	45	6		51	71	14		85
Texas	6	2		8	6		3	9
Utah	13			13	7		2	9
Virginia		10		10	3	15		18
West Virginia	358	430		788	410	491		901
Wyoming	42	17		59	46	26		72
Total	3,887	2,717	54	6,658	4,491	3,102	78	7,671

The statistics relating to the use of mining machines were first collected by the Survey for the year 1896. The inquiries at this time asked also for reports on the number of machines in use and the amount of coal won by them in 1891, five years previous. From the returns to the Survey since 1896, the results of which in detail have been published in the preceding volumes of Mineral Resources, the following table has been prepared showing the development in the use of the mechanical mining of bituminous coal since 1891:

Production of coal by machines in the United States since 1891.

Year.	Number of machines in use.	Total tonnage won by machines.	Average production for each machine.
		Short tons.	*Short tons.*
1891	545	6,211,732	11,398
1896	1,446	16,424,932	11,373
1897	1,956	22,649,220	11,579
1898	2,622	32,413,144	12,362
1899	3,125	43,963,933	14,068
1900	3,907	52,784,523	13,510
1901	4,341	57,843,335	13,325
1902	5,418	69,611,582	12,848
1903	6,658	77,974,894	11,712
1904	7,671	78,692,497	10,258

While there are a few exceptions to the rule, it generally appears that where there has been an increase in the percentage of the tonnage obtained by the use of mining machines in the bituminous regions, there has been an increase both for the year and for the day in the average production per man. A notable exception to this, however, is observed in the production of bituminous coal in Pennsylvania, where the machine-mined coal in 1903 was equal to 36.02 per cent and in 1904 to 35.91 per cent, while the average daily production per man increased from 3.4 to 3.7 per cent, but because of the fewer number of days worked in the year the average tonnage per man for the year decreased from 798 to 724.9 tons. Illinois, the second coal-producing State, shows a decrease from 19.97 to 19.50 in the percentage of the machine-mined coal to the total production, and the average daily tonnage per man indicates a decrease from 3.21 to 3.13. In West Virginia, the third State in producing rank, the machine-mined percentage increased from 27.93 to 29.22, while the average daily tonnage per man increased from 3.36 to 3.49. In Ohio the machine-mined percentage increased from 56.39 to 57.30, and the average daily tonnage per man from 3.05 to 3.2. In Alabama the machine-mined percentage increased from 4.95 to 6.6, and the average daily tonnage per man from 2.38 to 2.93. Another exception to be noted, however, is Indiana, whose machine-mined percentage increased from 30.9 to 33.66, while the average tonnage per day per man decreased from 3.22 to 3.13. In Colorado the machine-mined percentage decreased from 17.11 to 14.2, while the average daily tonnage per man decreased from 3.28 to 3.14. A notable instance of the increased efficiency per man was shown in Kentucky, where the average tonnage per man per day increased from 2.54 to 2.7, while the percentage of the machine-mined tonnage increased from 37.73 to 47.52. In the following table is presented a statement of the average yearly and daily production by each man employed during 1903 and 1904, by States, together with the total tonnage mined by the use of machines in each State and the percentage of the machine-mined tonnage to the total production.

Average production per man compared with production by machines in 1903 and 1904, by States.

[Short tons.]

State or Territory.	Average tonnage.				Production by machines.			
	Per year.		Per day.		Total tonnage by machines.		Per cent of machine coal to total.	
	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.
Alabama	543.6	632.3	2.38	2.93	577,317	741,170	4.95	6.58
Arkansas	536.2	438.7	2.40	2.66	....	....	......	......
Colorado	804.4	819.7	3.28	3.14	1,270,221	945,965	17.11	14.21
Illinois	731.0	667.0	3.21	3.13	7,381,027	7,110,902	19.97	19.50
Indiana	634.3	554.8	3.22	3.14	3,334,961	3,681,032	30.90	33.66
Indian Territory	457.0	359.9	1.85	1.80	73,304	42,594	2.08	1.40
Iowa	453.3	417.2	2	1.96	55,085	175,742	.86	2.70
Kansas	534.6	519.2	2.49	2.44	9,876	10,600	.17	.17
Kentucky	525.2	532.9	2.54	2.71	2,843,805	3,595,513	37.73	47.52
Maryland	827.1	848.8	3.78	3.76	401,144	484,373	8.28	10.06
Michigan	494.1	378.4	2.23	2.07	180,943	310,007	13.23	23.09
Missouri	444.1	411.2	2.07	2.00	311,602	376,505	7.35	9.03
Montana	691.0	542.5	2.72	2.23	693,504	482,924	46.58	35.54
New Mexico	862.0	785.5	3.31	3.45	105,000	100,000	9.40	6.89
North Dakota	573.3	486.5	2.90	2.55	115,222	125,097	41.35	47.01
Ohio	592.0	559.3	3.05	3.20	14,007,326	14,001,647	56.39	57.31
Pennsylvania:								
Anthracite	495.8	469.4	2.41	2.35	....	....	......	......
Bituminous	798.0	724.9	3.40	3.70	37,146,253	35,174,613	36.02	35.91
Tennessee	482.0	459.1	2.12	2.12	304,602	440,618	6.35	9.21
Texas	389.0	409.4	1.61	1.86	29,000	33,154	3.13	2.77
Utah	873.0	1,086.6	3.52	3.70	75,000	34,054	4.46	2.28
Virginia	615.0	660.0	2.30	2.76	82,040	245,536	2.38	6.85
Washington	670.0	593.5	2.35	2.44	....	....	......	......
West Virginia	706.0	686.6	3.36	3.49	8,193,840	9,526,749	27.93	29.22
Wyoming	928.4	914.9	3.68	3.49	783,822	1,053,702	16.91	20.35

PRICES.

The following tables show the fluctuations in the average prices prevailing in each State since 1900, and also the average prices for the total production of 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. From these tables it appears that the highest average price for anthracite coal since 1880 was that recorded in 1903. The average price for bituminous coal in 1903 was the highest in any year since 1881, inclusive.

Average prices for coal at the mines since 1900.

[Per short ton.]

State or Territory.	1900.	1901.	1902.	1903.	1904.
Alabama	$1.17	$1.10	$1.20	$1.22	$1.20
Arkansas	1.14	1.14	1.31	1.51	1.54
California	[a] 3.12	[a] 2.65	[a] 3.14	[a] 2.86	[a] 4.74
Colorado	1.12	1.13	1.13	1.23	1.31
Georgia	1.17	1.20	[b] 1.42	[b] 1.26	[b] 1.22
Idaho	5.00	....	[c] 2.50	3.10	3.95
Illinois	1.04	1.03	1.03	1.17	1.10
Indiana	1.03	1.01	1.10	1.23	1.11
Indian Territory	1.45	1.62	1.51	1.82	1.82
Iowa	1.38	1.39	1.47	1.65	1.61
Kansas	1.22	1.22	1.30	1.52	1.52
Kentucky	.92	.95	.99	1.06	1.04
Maryland	.98	.99	1.06	1.48	1.19
Michigan	1.48	1.41	1.71	1.97	1.81
Missouri	1.21	1.24	1.38	1.61	1.64
Montana	1.63	1.44	1.65	1.64	1.61
New Mexico	1.37	1.42	1.43	1.37	1.31
North Carolina	1.32	1.25	(*d*)	(*d*)	(*d*)
North Dakota	1.22	1.29	1.44	1.50	1.42
Ohio	1.02	1.00	1.14	1.29	1.09
Oregon	3.74	2.52	2.44	2.43	2.18
Pennsylvania bituminous	.97	.99	1.08	1.18	.96
Tennessee	1.14	1.12	1.23	1.25	1.18
Texas	1.63	1.72	1.64	1.62	1.66
Utah	1.26	1.26	1.14	1.20	1.30
Virginia	.89	.86	.80	.96	.86
Washington	1.90	1.66	1.72	1.69	1.63
West Virginia	.81	.87	1.01	1.17	.88
Wyoming	1.36	1.35	1.18	1.24	1.30
Total bituminous	1.04	1.04	1.12	1.24	1.10
Pennsylvania anthracite	1.49	1.67	1.84	2.04	1.90
General average	1.14	1.19	1.22	1.41	1.26

[a] Includes Alaska. [b] Includes North Carolina. [c] Includes Nebraska. [d] Included in Georgia.

Average price per short ton of coal in the United States for 25 years.

Year.	Anthracite.	Bituminous.	Year.	Anthracite.	Bituminous.
1880	$1.47	$1.25	1893	$1.59	$0.96
1881	2.01	1.12	1894	1.51	.91
1882	2.01	1.12	1895	1.41	.86
1883	2.01	1.07	1896	1.50	.83
1884	1.79	.94	1897	1.51	.81
1885	2.00	1.13	1898	1.41	.80
1886	1.95	1.05	1899	1.46	.87
1887	2.01	1.11	1900	1.49	1.04
1888	1.91	1.00	1901	1.67	1.05
1889	1.44	.99	1902	1.84	1.12
1890	1.43	.99	1903	2.04	1.24
1891	1.46	.99	1904	1.90	1.10
1892	1.57	.99			

LABOR TROUBLES.

The coal-mining industry of the United States was comparatively free from labor disturbances in 1903 and in somewhat less degree in 1904. The States most seriously affected by strikes during 1904 were Alabama, Colorado, and Ohio, although on account of the much larger production of Ohio than the other States the influence upon the total in that State for the year was not seriously felt. In Alabama, 9,518 out of a total of 17,811 men were idle for an average of 80 days, and the total time lost was equal to 20 per cent of the entire working time made in the State. In Colorado, 3,865 out of a total of 8,123 men were idle for an average of 125 days, and the total time lost was equal to nearly 24 per cent of the total time made. Alabama's production decreased from 11,654,324 short tons in 1903 to 11,262,046 tons in 1904, and Colorado decreased from 7,423,602 to 6,658,355 tons. In Ohio 11,412 men, out of a total of 43,691, were idle for an average of 45 days, but the total time lost was less than 7 per cent of the entire working time reported. In the anthracite region of Pennsylvania strikes occurred at five different mines, but they were all comparatively insignificant and were settled without material loss of time. The total number of men on strike at the five different mines in the anthracite region was 2,228, who lost an average of fifteen days each. The total number of men reported on strike in the bituminous mines was 75,433, and the average time lost per man 44 days. The total time lost by strikes throughout the United States in 1904 was a little less than 3 per cent of the total working days reported.

The statistics of labor troubles in the United States during 1903 and 1904, by States, are shown in the following tables:

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
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

Statistics of labor strikes in the coal mines of the United States in 1904.

State or Territory.	Number of men on strike.	Total days lost.	Average number of days lost per man.
Alabama	9,518	762,032	80
Arkansas	76	1,424	19
Colorado	3,865	481,482	125
Illinois	16,983	156,528	9
Indiana	1,061	22,963	18
Indian Territory	488	5,175	11
Iowa	8,303	173,781	21
Kansas	186	1,214	7
Kentucky	3,781	144,245	39
Maryland	....	....	....
Michigan	564	2,402	4
Missouri	1,844	26,312	14
Montana	792	37,140	47
New Mexico	556	73,090	131
North Dakota	175	6,300	36
Ohio	11,412	514,658	45
Pennsylvania	9,336	576,353	62
Tennessee	2,391	170,680	71
Texas	55	585	11
Utah	....	....	....
Washington	365	25,020	69
West Virginia	3,682	167,343	45
Wyoming	....	....	....
Total	75,433	3,348,727	44
Pennsylvania anthracite	2,228	34,103	15
Grand total	77,661	3,382,830	44

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 1904, 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 for the United States during 1904 were 8,573,518 long tons, valued at $28,238,008, of which 2,228,392 long tons, valued at $11,077,470 were anthracite, and 6,345,126 long tons, valued at $17,160,538 were bitumnious coal. The imports of anthracite were equal to about 0.02 per cent of the total production, and those of bituminous coal to 0.4 per cent. From this it can be seen that the imports of anthracite coal into the United States are of relatively no importance. Most of the anthracite imported is to San Francisco and other points on the Pacific coast, being brought in principally as ballast in vessels coming for outgoing cargoes. The principal increase has been in the imports of bituminous coal during the last four or five years. This has been due to the receipts of Nova Scotia coal at Everett, Mass., this fuel being used in the manufacture of coke in the retort oven plant of the New England Gas and Coke Company at that place. Compared with the domestic production, the total amount of coal imported into the United States is of little consequence, having for years averaged less than 1 per cent of the production.

Coal imported and entered for consumption in the United States, 1867–1904.

Year ending—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
June 30—	*Long tons.*		*Long tons.*	
1867	....	....	509,802	$1,412,597
1868	....	....	394,021	1,250,513
1869	....	....	437,228	1,222,119
1870	....	....	415,729	1,103,965
1871	973	$4,177	430,508	1,121,914
1872	390	1,322	485,063	1,279,686
1873	2,221	10,764	460,028	1,548,208
1874	471	3,224	492,063	1,937,274
1875	138	963	436,714	1,791,601
1876	1,428	8,560	400,632	1,592,846
1877	630	2,220	495,816	1,782,941
1878	158	518	572,846	1,929,660
1879	488	721	486,501	1,716,209
1880	8	40	471,818	1,588,312
1881	1,207	2,628	652,963	1,988,199
1882	36	148	795,722	2,141,373
1883	507	1,172	645,924	3,013,555
1884	1,448	4,404	748,995	2,494,228
1885	4,976	15,848	768,477	2,548,432
December 31—				
1886	2,039	4,920	811,657	2,501,153
1887	14,181	42,983	819,242	2,609,311
1888	24,093	68,710	1,085,647	3,728,060
1889	20,652	117,434	1,001,374	3,425,347
1890	15,145	46,695	819,971	2,822,216
1891	37,607	112,722	1,363,313	4,561,105
1892	65,058	197,583	1,143,304	3,744,862
1893	53,768	148,112	1,082,993	3,623,892
1894	90,068	234,024	1,242,714	3,785,513
1895	141,337	328,705	1,212,023	3,626,623
1896	101,689	237,717	1,211,448	3,453,742
1897	24,534	59,222	1,276,135	3,424,833
1898	3,149	8,609	1,277,070	3,569,743
1899	61	245	1,400,461	3,882,430
1900	118	549	1,909,258	5,019,553
1901	286	1,844	1,919,962	5,291,429
1902	[a] 170,211	792,469	[b] 2,470,902	6,984,668
1903	[a] 175,747	792,657	[b] 3,293,583	9,319,567
1904	72,529	220,664	[b] 1,550,751	3,895,469

[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 ½-inch screen imported in 1902, 577,274 tons imported in 1903, and 579,204 tons imported in 1904

Coal of domestic production exported from the United States, 1867–1904.

Year ending—	Anthracite.		Bituminous and shale.	
	Quantity.	Value.	Quantity.	Value.
June 30—	*Long tons.*		*Long tons.*	
1867	192,912	$1,333,457	92,189	$512,742
1868	192,291	1,082,745	86,367	433,475
1869	283,783	1,553,115	....	....
1870	121,098	803,135	106,820	502,223
1871	134,571	805,169	133,380	564,067
1872	259,567	1,375,342	141,311	586,264
1873	342,180	1,827,822	242,453	1,086,253
1874	401,912	2,236,084	361,490	1,587,666
1875	316,157	1,791,626	203,189	828,943
1876	337,934	1,869,434	230,144	850,711
1877	418,791	1,891,351	321,665	1,024,711
1878	319,477	1,006,843	340,661	1,352,624
1879	386,916	1,427,886	276,000	891,512
1880	392,626	1,362,901	222,634	695,179
1881	462,208	2,091,928	191,038	739,532
1882	553,742	2,589,887	314,320	1,102,898
1883	557,813	2,648,033	463,051	1,593,214
1884	649,040	3,053,550	646,265	1,977,959
1885	588,461	2,586,421	683,481	1,989,541
December 31—				
1886	667,076	2,718,143	544,768	1,440,631
1887	825,486	3,469,166	706,364	2,001,966
1888	969,542	4,325,126	860,462	2,529,472
1889	857,632	3,636,347	935,151	2,783,592
1890	794,335	3,272,697	1,280,930	4,004,995
1891	861,251	3,577,610	1,615,869	5,104,850
1892	851,639	3,722,903	1,645,869	4,999,289
1893	1,333,287	6,241,007	2,324,591	6,009,801
1894	1,440,625	6,359,021	2,195,716	4,970,270
1895	1,470,710	5,937,130	2,211,983	4,816,847
1896	1,350,000	5,925,506	2,276,202	5,072,818
1897	1,298,768	5,836,730	2,399,263	5,326,761
1898	1,350,948	5,712,985	3,152,459	6,699,248
1899	1,707,796	7,140,100	4,044,354	8,573,276
1900	1,654,610	7,092,489	6,262,909	14,431,590
1901	1,993,307	8,937,147	5,390,086	13,085,763
1902	907,977	4,301,946	5,218,969	13,927,063
1903	2,008,857	9,780,044	6,303,241	17,410,385
1904	2,228,392	11,077,470	6,345,126	17,160,538

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 (1904)	long tons	314,562,881	352,310,427
Great Britain (1904) *a*	do	232,422,000	260,312,640
Germany (1904) *a*	metric tons	169,448,272	186,731,996
Austria-Hungary (1903)	do	40,628,785	44,772,921
France (1903)	do	34,906,418	38,466,873
Belgium (1903)	do	23,796,680	26,223,941
Russia (1903)	do	17,500,000	19,285,000
Japan (1902)	do	9,701,682	10,691,254
Canada (1903)	short tons	7,643,999	7,643,999
India (1903)	long tons	7,438,386	8,330,992
New South Wales (1903)	do	6,354,846	7,117,428
Spain (1903)	metric tons	2,587,652	2,851,593
South African Republic (1903)	long tons	2,258,284	2,529,278
New Zealand (1903)	do	1,420,229	1,590,656
Mexico (1902)	metric tons	709,848	782,252
Sweden (1903)	do	320,390	353,070
Italy (1903)	do	346,887	382,269
Holland (1902)	do	399,133	439,845
Queensland (1903)	long tons	507,801	568,737
Victoria (1903)	do	69,861	78,244
Natal (1903)	do	713,548	799,174
Cape Colony (1902)	do	165,557	185,424
Tasmania (1903)	do	49,069	54,957
Other countries *b*	do	4,986,403	5,584,771
Total			978,087,741
Percentage of the United States			36

a Preliminary figures.
b Includes China, Turkey, Servia, Portugal, United States of Colombia, Chile, Borneo and Labuan, Peru, Greece, etc.

World's production of coal, by countries, 1868–1904.

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	41,440,605
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	63,822,830	71,481,570	146,969,409	164,605,738	59,118,035	65,177,634
1881	76,679,491	85,881,030	154,184,300	172,686,416	61,540,485	67,848,385
1882	92,456,419	103,551,189	156,499,977	175,279,974	65,378,211	72,079,478
1883	103,310,290	115,707,525	163,737,327	183,385,806	70,442,648	77,663,019
1884	107,281,742	120,155,551	160,757,779	180,048,712	72,113,820	79,505,487
1885	99,250,263	111,160,295	159,351,418	178,473,588	73,675,515	81,227,255
1886	101,500,381	113,680,427	157,518,482	176,420,700	73,682,584	81,235,049
1887	116,652,242	130,650,511	162,119,812	181,574,189	76,232,618	84,046,461
1888	132,731,837	148,659,657	169,935,219	190,327,445	81,960,083	90,360,992
1889	126,097,779	141,229,513	176,916,724	198,146,731	84,973,230	93,640,500
1890	140,866,931	157,770,963	181,614,288	203,408,003	89,290,834	98,398,500
1891	150,505,954	168,566,669	185,479,126	207,736,621	94,252,278	103,913,136
1892	160,115,242	179,329,071	181,786,871	203,601,296	92,544,050	102,029,815
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	178,776,070	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	240,789,310	269,684,027	225,181,300	252,203,056	149,551,000	164,805,202
1901	261,874,836	293,299,816	219,046,945	245,332,578	152,628,931	168,217,082
1902	269,277,178	301,590,439	227,095,042	254,346,447	150,436,810	165,826,496
1903	319,068,229	357,356,416	230,334,469	257,974,605	162,457,253	179,076,630
1904	314,562,881	352,310,427	232,422,000	260,312,640	169,448,272	186,731,996

World's production of coal, by countries, 1868–1904—Continued.

Year.	Austria-Hungary.		France.		Belgium.	
	Metric tons.	Short tons.	Metric tons.	Short tons.	Metric tons.	Short tons.
1868	7,021,756	7,741,486	13,330,826	14,697,236	12,298,589	13,559,194
1869	7,663,043	8,448,505	13,509,745	14,894,494	12,943,994	14,270,753
1870	8,355,945	9,212,429	13,179,788	14,530,716	13,697,118	15,101,073
1871	8,437,401	9,302,235	13,240,135	14,597,249	13,733,176	15,140,827
1872	8,825,896	9,730,550	16,100,773	17,751,102	15,658,948	17,263,990
1873	10,104,769	11,140,508	17,479,341	19,270,973	15,778,401	17,395,687
1874	12,631,364	13,926,079	16,907,913	18,640,974	14,669,029	16,172,604
1875	13,062,738	14,395,137	16,956,840	18,694,916	15,011,331	16,549,992
1876	13,000,000	14,327,300	17,101,448	18,854,346	14,329,578	15,798,360
1877	13,500,000	14,883,750	16,804,529	18,526,993	13,669,077	15,070,157
1878	13,900,000	15,324,750	16,960,916	18,699,410	14,899,175	16,426,340
1879	14,500,000	15,986,250	17,110,979	18,864,854	15,447,292	17,030,640
1880	14,800,000	16,317,000	19,361,564	21,346,124	16,886,698	18,617,585
1881	15,304,813	16,873,556	19,765,983	21,791,996	16,873,951	18,603,531
1882	15,555,292	17,149,709	20,603,704	22,715,584	17,590,989	19,394,065
1883	17,047,961	18,795,377	21,333,884	23,520,607	18,177,754	20,040,974
1884	18,000,000	19,845,000	20,023,514	22,075,924	18,051,499	19,901,778
1885	20,435,463	22,530,098	19,510,530	21,510,359	17,437,603	19,224,957
1886	20,779,441	22,909,334	19,909,894	21,950,658	17,285,543	19,057,311
1887	21,879,172	24,121,787	21,287,589	23,469,567	18,378,624	20,262,433
1888	23,859,608	26,305,218	22,602,894	24,919,691	19,218,481	21,188,375
1889	25,328,417	27,924,580	24,303,509	26,794,619	19,869,980	21,906,653
1890	27,504,032	30,323,195	26,083,118	28,756,638	20,365,960	22,453,471
1891	28,823,240	31,777,622	26,024,893	28,692,444	19,675,644	21,692,398
1892	29,037,978	32,014,371	26,178,701	28,862,018	19,583,173	21,590,448
1893	30,449,304	33,570,358	25,650,981	28,280,207	19,410,519	21,400,097
1894	31,492,000	34,704,184	27,459,137	30,273,699	20,458,827	22,555,857
1895	32,654,777	35,985,564	28,019,893	30,877,922	20,450,604	22,536,566
1896	33,676,411	37,111,405	29,189,900	32,167,270	21,252,370	23,420,112
1897	35,858,000	39,515,516	30,797,629	33,938,987	21,534,629	23,731,161
1898	37,786,963	41,652,569	32,356,104	35,656,426	22,075,093	24,326,752
1899	38,739,000	42,690,378	32,863,000	36,215,026	21,917,740	24,159,925
1900	39,029,729	43,010,761	33,404,298	36,811,536	23,462,817	25,856,024
1901	41,202,902	45,417,959	32,301,757	35,596,536	22,213,410	24,485,842
1902	39,479,560	43,518,319	30,196,994	33,286,146	22,877,470	25,217,835
1903	40,628,785	44,772,921	34,906,418	38,466,873	23,796,680	26,223,941
1904	....	....	....	....	....	....

World's production of coal, by countries, 1868–1904—Continued.

Year.	Russia.		Japan.		Other countries.	Total.	Per cent of United States.
	Metric tons.	Short tons.	Metric tons.	Short tons.	Short tons.	Short tons.	
1868....	430,032	473,895	....	....	1,147,330	221,035,430	14.32
1869....	579,419	638,510	....	....	1,104,563	229,200,013	13.81
1870....	667,806	735,922	....	....	1,063,121	238,621,068	15.42
1871....	772,371	851,153	....	....	1,114,248	260,526,424	17.79
1872....	1,037,611	1,143,447	....	....	1,268,115	283,002,843	17.97
1873....	1,154,618	1,272,389	....	....	1,502,516	302,703,376	18.87
1874....	1,270,889	1,400,520	....	....	2,708,756	298,616,379	17.60
1875....	1,673,753	1,844,475	....	....	2,639,104	308,419,177	16.95
1876....	1,795,146	1,968,251	....	....	2,597,143	311,594,969	17.07
1877....	1,760,276	1,939,824	....	....	2,821,155	317,118,648	19.05
1878....	2,483,575	2,738,141	....	....	3,176,050	318,441,990	18.17
1879....	2,874,790	3,169,456	....	....	3,362,605	335,332,908	20.34
1880....	3,238,470	3,570,413	....	....	3,621,342	369,413,780	20.62
1881....	3,439,787	3,792,365	....	....	5,185,974	392,663,253	21.87
1882....	3,672,782	4,049,242	....	....	6,128,631	420,082,472	24.58
1883....	3,916,105	4,317,506	1,021,000	1,125,142	6,929,841	450,990,397	25.55
1884....	3,869,689	4,266,332	1,159,000	1,277,218	7,367,309	454,022,811	26.37
1885....	4,207,905	4,639,215	1,314,000	1,448,028	7,570,507	447,783,802	24.82
1886....	4,506,027	4,967,895	1,402,000	1,545,004	9,082,815	450,848,793	25.22
1887....	4,464,174	4,921,752	1,785,000	1,967,070	10,399,273	481,412,743	27.14
1888....	5,187,312	5,719,011	2,044,000	2,252,488	11,493,176	521,225,803	28.52
1889....	6,215,577	6,852,674	2,435,000	2,683,370	12,618,299	531,797,039	26.56
1890....	6,016,525	6,633,219	2,653,000	2,923,606	13,025,637	563,693,232	27.99
1891....	6,233,020	6,871,905	3,230,000	3,559,460	14,744,329	587,554,583	28.69
1892....	6,816,323	7,514,996	3,228,000	3,557,256	14,998,633	593,497,904	30.22
1893....	7,535,000	8,307,337	3,350,000	3,691,700	15,783,599	582,638,296	31.30
1894....	8,629,000	9,509,158	4,311,000	4,750,722	18,197,510	610,487,368	27.97
1895....	9,079,138	10,005,210	4,849,000	5,343,598	19,428,643	644,177,076	29.98
1896....	9,229,000	10,170,358	5,019,690	5,531,698	20,866,748	664,001,718	28.92
1897....	11,207,475	12,350,638	5,647,751	6,225,516	22,074,093	697,213,515	28.72
1898....	12,307,450	13,562,810	6,761,301	7,572,657	24,797,873	738,129,608	29.80
1899....	13,562,810	15,730,346	6,716,831	7,401,948	25,811,285	801,976,021	31.63
1900....	16,151,557	17,799,016	7,429,457	8,187,262	27,684,964	846,041,848	31.88
1901....	16,269,800	17,934,201	8,945,938	9,861,107	30,565,923	870,711,044	33.69
1902....	15,259,674	17,090,835	9,701,682	10,691,254	[a] 37,907,163	888,644,787	33.94
1903....	17,500,000	19,285,000	....	([b])	[a] 39,292,689	973,140,329	36.72
1904....	....	....	....	....	....	....	....

[a] This includes, in addition to the countries named in the following pages, the output of Holland, Natal, Cape Colony, Tasmania, Mexico, China, Turkey, Servia, Portugal, etc. (estimated), 5,584,771 tons.

[b] Latest available figures are used in making up totals for 1903.

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	951, 231	1, 068, 739	19, 611	21, 964	....	....
1869	919, 774	1, 030, 147	11, 120	12, 454	....	....
1870	868, 564	972, 791	22, 639	25, 356	....	....
1871	898, 784	1, 006, 638	17, 000	19, 040	....	....
1872	1, 012, 426	1, 133, 917	27, 727	31, 054	....	....
1873	1, 192, 862	1, 336, 005	33, 613	37, 647	....	....
1874	1, 304, 567	1, 461, 115	43, 443	48, 656	....	....
1875	1, 329, 729	1, 489, 296	32, 107	35, 960	....	....
1876	1, 319, 918	1, 478, 308	50, 627	56, 702	....	....
1877	1, 444, 271	1, 617, 584	60, 918	68, 228	....	....
1878	1, 575, 497	1, 764, 556	52, 580	58, 890	162, 218	181, 684
1879	1, 583, 381	1, 773, 387	55, 012	61, 613	231, 218	258, 964
1880	1, 466, 180	1, 642, 122	58, 052	65, 018	299, 623	335, 913
1881	1, 769, 597	1, 981, 949	65, 612	73, 485	337, 262	377, 733
1882	2, 109, 282	2, 362, 396	74, 436	83, 368	378, 272	423, 665
1883	2, 521, 457	2, 824, 032	104, 750	117, 320	421, 764	472, 376
1884	2, 749, 109	3, 079, 002	120, 727	135, 214	480, 831	538, 531
1885	2, 878, 863	3, 224, 327	209, 698	234, 862	511, 063	572, 390
1886	2, 830, 175	3, 169, 796	228, 656	256, 094	534, 353	598, 475
1887	2, 922, 497	3, 273, 197	238, 813	267, 470	558, 620	625, 654
1888	3, 203, 444	3, 587, 857	311, 412	348, 781	613, 895	687, 562
1889	3, 655, 632	4, 094, 308	265, 507	297, 368	586, 445	656, 818
1890	3, 060, 876	3, 428, 181	338, 344	378, 945	637, 397	713, 885
1891	4, 037, 929	4, 522, 480	271, 603	304, 195	668, 794	749, 049
1892	3, 780, 968	4, 234, 684	265, 086	296, 896	673, 315	754, 113
1893	3, 278, 328	3, 671, 727	264, 403	296, 131	691, 548	774, 534
1894	3, 672, 076	4, 112, 725	270, 705	303, 190	719, 546	805, 892
1895	3, 737, 536	4, 186, 040	322, 977	361, 734	727, 000	814, 240
1896	3, 909, 517	4, 378, 659	371, 000	415, 520	793, 000	888, 160
1897	4, 383, 591	4, 909, 622	358, 407	401, 416	840, 713	941, 600
1898	4, 736, 000	5, 304, 320	407, 819	456, 757	906, 778	1, 015, 591
1899	4, 597, 028	5, 148, 671	494, 009	553, 290	975, 234	1, 092, 262
1900	5, 507, 497	6, 168, 397	497, 132	556, 788	1, 093, 990	1, 225, 269
1901	5, 968, 426	6, 684, 637	539, 472	604, 209	1, 227, 638	1, 374, 955
1902	5, 942, 011	6, 655, 052	501, 531	561, 715	1, 362, 702	1, 526, 226
1903	6, 354, 846	7, 117, 428	507, 801	568, 737	1, 420, 229	1, 590, 656

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	....	....	933,803	....	....	....	....
1877	....	....	1,002,395	....	....	....	....
1878	....	....	1,034,081	....	....	....	....
1879	....	....	1,123,863	....	....	....	....
1880	....	....	1,424,635	....	....	....	....
1881	....	....	1,487,182	997,543	1,117,248	....	....
1882	....	....	1,811,708	1,130,242	1,265,871	....	....
1883	....	....	1,806,259	1,315,976	1,473,893	....	....
1884	....	....	1,950,080	1,266,312	1,418,269	....	....
1885	....	....	1,879,470	1,294,221	1,449,528	....	....
1886	....	....	2,091,976	1,401,295	1,569,450	1,001,432	1,104,079
1887	....	....	2,418,494	1,560,393	1,747,640	1,038,305	1,144,731
1888	....	....	2,658,134	1,802,876	2,019,221	1,036,565	1,142,813
1889	14,421	16,152	2,719,478	2,045,359	2,290,802	1,153,755	1,272,015
1890	20,750	23,240	3,117,661	2,168,521	2,438,744	1,212,089	1,336,328
1891	22,834	25,574	3,623,076	2,328,577	2,608,006	1,287,988	1,420,007
1892	23,363	26,166	3,292,547	2,537,696	2,842,220	1,461,196	1,610,969
1893	91,726	102,733	3,201,742	2,529,855	2,833,438	1,484,794	1,636,986
1894	175,175	196,196	3,903,913	2,810,929	3,158,240	1,657,010	1,830,853
1895	194,171	217,472	3,512,504	3,538,000	3,962,560	1,783,783	1,965,729
1896	227,000	255,240	3,743,234	3,848,000	4,309,760	1,878,399	2,069,996
1897	236,277	264,630	3,786,107	4,063,127	4,550,702	1,939,400	2,137,219
1898	245,659	275,138	4,172,655	4,203,199	4,707,582	2,526,600	2,784,313
1899	262,380	293,866	4,925,051	5,093,260	5,704,451	2,742,389	3,022,113
1900	211,596	236,988	5,322,197	6,118,692	6,852,935	2,674,105	2,946,864
1901	209,329	234,448	6,186,286	6,635,727	7,432,014	2,747,724	3,027,992
1902	225,164	252,184	7,639,225	7,433,972	8,326,049	2,807,550	3,094,762
1903	69,861	78,244	7,643,999	7,438,386	8,330,992	2,587,652	2,851,593

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	93,555	103,144				
1873	116,884	128,864				
1874	127,473	140,539				
1875	116,955	128,943				
1876	116,399	128,330				
1877	120,588	132,948				
1878	124,117	136,839				
1879	131,318	144,778				
1880	139,369	153,654				
1881	134,582	148,377				
1882	164,737	181,623				
1883	214,121	235,961				
1884	223,322	246,213				
1885	190,413	209,930				
1886	243,325	268,266				
1887	327,665	361,251				
1888	366,794	404,390				
1889	390,320	432,533				
1890	376,326	415,500	187,512	206,132		
1891	289,286	318,938	198,033	218,331		
1892	295,713	326,024	199,380	219,816		
1893	317,249	349,767	199,933	220,426	548,534	614,358
1894	271,395	299,103	213,633	235,532	791,358	886,321
1895	305,321	336,563	223,652	246,464	1,133,466	1,269,482
1896	276,197	304,369	226,000	249,052	1,437,297	1,609,772
1897	314,222	346,273	224,343	251,264	1,600,212	1,792,237
1898	341,327	376,245	236,277	260,448	1,907,271	2,136,143
1899	388,534	428,164	239,344	263,757	1,464,317	1,640,035
1900	480,859	529,907	252,320	278,057	433,948	486,022
1901	425,614	469,154	271,509	299,284	671,532	752,116
1902	413,810	456,143	304,733	335,907	1,590,330	1,781,170
1903	346,887	382,269	320,390	353,070	2,258,284	2,529,278

PRODUCTION OF COAL, BY STATES.

Including Alaska, Idaho, and Nevada, in each of which a few hundred tons of coal were produced in 1904, there were 31 States and Territories which contributed to the total production of the United States in that year. In addition to the 3 mentioned, there were 4 whose output in 1904 was less than 1,000,000 tons; 12, the same number in 1904 as in 1903, produced between 1,000,000 and 5,000,000 tons each; 5, a gain of 1 over 1903, produced between 5,000,000 and 10,000,000 tons each; 2, Alabama and Indiana, produced over 10,000,000 tons and less than 12,000,000; 1, Ohio, produced nearly 25,000,000 tons; West Virginia produced over 32,000,000 tons; Illinois, over 36,000,000, and Pennsylvania, over 170,000,000 tons. Of the 31 coal-producing States and Territories, 13 are east of the Mississippi River and 18 are west of it. The 13 States east of the Mississippi River produced, in 1904, 309,297,352 short tons, or nearly 88 per cent of the total product, while the 18 States and Territories west of the Mississippi River produced 43,013,075 short tons, or a little over 12 per cent. Of the 13 States east of the Mississippi River, 6 are located north of the Ohio and Potomac rivers, and 7 lie south of those natural boundary lines. The 6 States north of the Ohio and Potomac and east of the Mississippi rivers produced, in 1904, 249,109,689 short tons, 71 per cent of the total output of the United States and 80 per cent of the production east of the Mississippi River; while the Southern States produced 60,187,663 short tons, 17 per cent of the total production and nearly 20 per cent of the production east of the Mississippi River.

In the following table the statistics of production in the States east of the Mississippi River and divided by the Ohio and Potomac rivers and the States west of the Mississippi River are given for the years 1880, 1890, 1900, 1903, and 1904, in order that the development in these regions may be comparatively shown. It will be observed that since 1880, in the States north of the Ohio and Potomac rivers and east of the Mississippi River, the production has grown from 63,044,558 short tons to 249,109,689 short tons, the output in 1904 being not quite four times that of 1880. The Southern States, while not approaching their Northern neighbors in the amount of the total output, have shown a much more rapid growth. In 1880 the States south of the Ohio and Potomac rivers produced a total of 3,793,308 short tons, and in 1904, 60,187,663 short tons, the output in 1904 being more than sixteen times that of 1880 and indicating, comparatively speaking, that the progress in the Southern States was more than four times that of the Northern ones. During the same period the production west of the Mississippi River has grown from 4,624,324 short tons in 1880 to 43,013,075 short tons in 1904, or more than nine times. It will also be observed that the Southern States are the only ones which showed an increase of production in 1904, as compared with 1903, this being due principally to the increased activity in West Virginia, although Kentucky and Virginia also showed less important increases.

Coal production in States north of Ohio and Potomac rivers in 1880, 1890, 1900, 1903, and 1904.

State.	1880.		1890.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Illinois	6,115,377	$8,779,832	15,292,420	$14,171,230	25,767,981	$26,927,185
Indiana	1,454,327	2,150,258	3,305,737	3,259,233	6,484,086	6,687,137
Maryland	2,228,917	2,585,537	3,357,813	2,899,572	4,024,688	3,927,381
Michigan	100,800	224,500	74,977	149,195	849,475	1,259,683
Ohio	6,008,595	7,719,667	11,494,506	10,783,171	18,988,150	19,292,246
Pennsylvania:						
Anthracite	28,711,379	42,282,948	46,468,641	66,383,772	57,367,915	85,757,851
Bituminous	18,425,163	18,567,129	42,302,173	35,376,916	79,842,326	77,438,545
Total	63,044,558	82,309,871	122,296,267	133,023,089	193,324,621	221,290,028

State.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Illinois	36,957,104	$43,196,809	36,475,060	$39,941,993
Indiana	10,794,692	13,244,817	10,934,379	12,105,709
Maryland	4,846,165	7,189,784	4,813,622	5,729,085
Michigan	1,367,619	2,707,527	1,342,840	2,424,935
Ohio	24,838,103	31,932,327	24,434,812	26,588,476
Pennsylvania:				
Anthracite	74,607,068	152,036,448	73,156,709	138,974,020
Bituminous	103,117,178	121,752,759	97,952,267	94,434,219
Total	256,527,929	372,060,471	249,109,689	320,198,437

Coal production in States south of Ohio and Potomac rivers in 1880, 1890, 1900, 1903, and 1904.

State.	1880.		1890.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Alabama	323,972	$476,911	4,090,409	$4,202,469	8,394,275	$9,793,785
Georgia	154,644	231,605	228,337	238,315	315,557	370,022
Kentucky	946,288	1,134,960	2,701,496	2,472,119	5,328,964	4,881,577
North Carolina	350	400	10,262	17,864	17,734	23,447
Tennessee	495,131	629,724	2,169,585	2,395,746	3,509,562	4,003,082
Virginia	43,079	99,802	784,011	589,925	2,393,754	2,123,222
West Virginia	1,829,844	2,013,671	7,394,654	6,208,128	22,647,207	18,416,871
Total	3,793,308	4,587,073	17,378,754	16,124,566	42,607,053	39,612,006

State.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Alabama	11,654,324	$14,246,798	11,262,046	$13,480,111
Georgia	416,951	521,459	383,191	466,496
Kentucky	7,538,032	7,979,342	7,566,482	7,857,691
North Carolina	17,309	25,300	7,000	10,500
Tennessee	4,798,004	5,979,830	4,782,211	5,642,393
Virginia	3,451,307	3,302,149	3,583,914	3,076,011
West Virginia	29,337,241	34,297,019	32,602,819	28,807,420
Total	57,213,168	66,351,897	60,187,663	59,340,622

Coal production in States west of Mississippi River in 1880, 1890, 1900, 1903, and 1904.

State or Territory.	1880.		1890.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Arkansas	14,778	$33,535	399,888	$514,595	1,447,945	$1,653,618
California	236,950	663,013	110,711	283,019	172,908	540,031
Colorado	462,747	1,041,350	3,094,003	4,344,196	5,244,364	5,858,036
Idaho					10	50
Indian Territory			869,229	1,579,188	1,922,298	2,788,124
Iowa	1,461,116	2,507,453	4,021,739	4,995,739	5,202,939	7,155,341
Kansas	771,442	1,517,444	2,259,922	2,947,517	4,467,870	5,454,691
Missouri	884,304	1,464,425	2,735,221	3,382,858	3,540,103	4,280,328
Montana	224	800	517,477	1,252,492	1,661,775	2,713,707
Nebraska	200	750	1,500	4,500		
New Mexico			375,777	504,390	1,299,299	1,776,170
North Dakota			30,000	42,000	129,883	158,348
Oregon	43,205	97,810	61,514	177,875	58,864	220,001
Texas			184,440	465,900	968,373	1,581,914
Utah	14,748	33,645	318,159	552,390	1,147,027	1,447,750
Washington	145,015	389,046	1,263,689	3,426,590	2,474,093	4,700,068
Wyoming	589,595	1,080,451	1,870,366	3,183,669	4,014,602	5,457,953
Total	4,624,324	8,829,722	18,113,635	27,656,918	33,752,353	45,786,130

State or Territory.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Arkansas	2,229,172	$3,360,831	2,009,451	$3,102,660
California	[a] 105,420	301,318	[a] 79,582	[a] 377,306
Colorado	7,423,602	9,150,943	6,658,355	8,751,821
Idaho	4,250	13,250	[b] 3,480	[b] 13,730
Indian Territory	3,517,388	6,386,463	3,046,539	5,532,066
Iowa	6,419,811	10,563,910	6,519,933	10,504,406
Kansas	5,839,976	8,871,953	6,333,307	9,640,771
Missouri	4,238,586	6,834,297	4,168,308	6,837,886
Montana	1,488,810	2,440,846	1,358,919	2,194,548
Nebraska				
New Mexico	1,541,781	2,105,785	1,452,325	1,904,499
North Dakota	278,645	418,005	266,128	378,032
Oregon	91,144	221,031	111,540	243,588
Texas	926,759	1,505,383	1,195,944	1,983,636
Utah	1,681,409	2,026,038	1,493,027	1,943,440
Washington	3,193,273	5,380,679	3,137,681	5,120,931
Wyoming	4,635,293	5,731,281	5,178,556	6,747,909
Total	43,615,319	65,312,013	43,013,075	65,277,229

[a] Includes Alaska. [b] Includes Nevada.

The production of coal in the several States and Territories in 1904 and preceding years is discussed more in detail in the following pages.

ALABAMA.

Total production in 1904, 11,262,046 short tons; spot value, $13,480,111.

The coal fields of Alabama form the southwestern extremity of the great Appalachian system which extends in a northeasterly-southwesterly direction from the northern part of Pennsylvania to the central part of Alabama. The coal-bearing formations, which become quite narrow in passing through Tennessee, widen out abruptly in the northern part of Alabama and cover about 40 per cent of the northern half of the State. The coal-producing areas within the State are divided into four distinct basins or districts, three of which—the Warrior, Cahaba, and Coosa—derive their names from the rivers which drain them.

The Warrior basin forms the southern portion of the Cumberland Plateau. The Cahaba and Coosa basins, long, narrow synclines, are separated from each other and from the Warrior basin on the west by narrow anticlines and fault valleys.

The Blount Mountain basin is a synclinal spur extending from the Walden Ridge, in Tennessee, and is separated from the Warrior basin by Murfrees Valley.

All of the coal produced in Alabama is of the bituminous variety, and a large proportion of it is coking coal. During the last decade a great number of coal-washing plants have been installed by some of the more important producers in the Birmingham district, and it has been found that the average quality of the coke has been considerably improved thereby. At the present time about 70 per cent of the coal made into coke in Alabama is washed before coking. About two-thirds of the coal charged into the coke ovens is slack produced in mining operations. The total amount of coal charged into the ovens represents something over 25 per cent of the total product of the State. The yield of coal in coke varies from 56 to 60 per cent.

The total coal-bearing area of Alabama is estimated at 6,000 square miles, underlying 19 counties, all of which are north of a line drawn midway across the State from east to west. In only 13 of these counties, however, is coal produced on a commercial scale. The 13 coal-producing counties are Bibb, Blount, Cullman, Dekalb, Etowah, Jackson, Jefferson, Marion, St. Clair, Shelby, Tuscaloosa, Walker, and Winston. The principal coal-producing county is Jefferson, which contributes more than 50 per cent of the total output of the State, and in which are located the iron furnaces of Birmingham and its vicinity. Walker County, the second in importance, produces about 23 per cent of the total, and Bibb County, the third in importance, produces something less than 15 per cent of the total.

Alabama is one of the 22 States whose coal output in 1904 exhibited a decrease as compared with the preceding year. In Alabama the decreased production was due for the most part to labor troubles in some of the larger mines in the State, particularly in those of the Tennessee Coal, Iron and Railroad Company and of the Sloss-Sheffield Steel and Iron Company. In the Pratt mines of the former company 1,650 men went on strike in July and had not returned to work before the close of the year. At the Brookside, Coalburg, and Blossburg mines of the latter company about 2,000 men were on strike from July 1 to the end of the year. The total working time lost by strikes in the State last year was equivalent to 20 per cent of the total time made. Had it not been for this lost time the total production for the State would probably have amounted to between 12,500,000 and 13,000,000 short tons. As it was, however, the production fell off from 11,654,324 short tons in 1903 to 11,262,046 short tons in 1904, a decrease of 392,278 short tons, or 3.4 per cent. The value decreased from $14,246,798 to $13,480,111, a loss of $766,687, or 5.4 per cent. The average price per ton for all coal mined and sold or used in Alabama in 1904 was $1.20 per short ton, against $1.22 in 1903, when prices in Alabama, as in nearly all other bituminous coal-producing States, were advanced by the abnormal conditions brought about by the strike in the anthracite regions of Pennsylvania in 1902.

The total number of men employed in the coal mines of Alabama in 1904 was 17,811 for an average of 216 days, as compared with 21,438 men for 228 days in 1903, and 16,439 men for 256 days in 1902. Of the total number employed in 1904, 876 men, distributed among 17 mines, worked eight hours per day; 5,763 men, at 50 mines, worked nine hours, and 8,409 men, at 50 mines, worked ten hours. The number of hours to the day for the other 3,460 men was not reported. The average number of tons mined for each man employed in 1904 was 632.3, as compared with 543.6 in 1903 and 630 in 1902. Dividing these by the average number of working days in each of these years we find that the average tonnage per day per man was 2.46 in 1902, 2.38 in 1903, and 2.93 in 1904, indicating that the loss in production at the mines affected by strikes was partly made up by greater individual effort on the part of the workmen at the mines not so affected. The use of mining machines, while showing an increase in 1904 over 1903, did not materially affect the averages. During 1904 the amount of coal undercut by machines was 741,170 short tons, as compared with 577,317 short tons in 1903. The number of machines reported in use in 1904 was 141, against 98 in 1903. There were 10 other machines installed in 1904, 5 of which were experimental and 5 were not in use during the year.

The statistics of production in Alabama in 1903 and 1904, by counties, with the distribution of the product for consumption, are shown in the following tables:

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	481
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	706,235	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.

Coal production of Alabama in 1904, 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	1,335,727	4,207	46,145	....	1,386,079	$1,913,225	$1.38	228	1,962
Etowah	128,739	10	240	....	128,989	149,834	1.16	209	261
Jefferson	3,644,904	25,530	151,877	1,999,352	5,821,663	6,808,349	1.17	213	8,927
St. Clair	136,407	580	7,236	....	144,223	171,357	1.19	223	285
Shelby	120,064	882	7,361	....	128,307	205,914	1.60	197	361
Tuscaloosa	161,858	1,774	13,981	485,799	663,412	767,204	1.16	240	951
Walker	2,336,460	12,754	45,804	188,455	2,583,473	2,945,473	1.14	213	4,176
Winston	40,356	....	....	....	40,356	64,495	1.60	170	145
Other counties and small mines [a]	290,973	36,350	7,028	31,193	365,544	454,260	1.25	227	743
Total	8,195,488	82,087	279,672	2,704,799	11,262,046	13,480,111	1.20	216	17,811

[a] Blount, Cullman, Dekalb, Jackson, and Marion.

In the following table is presented a statement of the production of coal in Alabama during the last five years and the increases and decreases in 1904 as compared with 1903:

Coal production of Alabama, 1900-1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase in 1904.	Decrease in 1904.
Bibb	964,785	1,258,853	1,487,407	1,651,157	1,386,079	....	265,078
Blount, Cullman	18,572	143,697	[a] 253,178	[a] 260,802	[a] 279,070	18,268	....
Etowah	20,855	93,591	101,790	119,830	128,989	9,159	....
Jefferson	5,255,296	5,549,715	5,855,536	6,194,832	5,821,663	....	373,169
St. Clair	156,270	140,816	156,243	152,313	144,223	....	8,090
Shelby	135,832	149,132	136,043	240,962	128,307	....	112,655
Tuscaloosa	268,422	374,718	431,711	610,392	663,412	53,020	....
Walker	1,489,380	1,284,025	1,903,976	2,365,385	2,583,473	218,088	....
Winston	[a] 49,863	69,505	28,686	50,841	40,356	....	10,485
Other counties and small mines	35,000	35,000	([b])	7,810	[c] 86,474	78,664	....
Total	8,394,275	9,099,052	10,354,570	11,654,324	11,262,046	....	[d] 392,278

[a] Includes production of Marion County.
[b] Small-mine production included in county distribution.
[c] Includes Dekalb and Jackson counties.
[d] Net decrease.

It will be observed in the foregoing table that the principal decreases in production were recorded in Bibb, Jefferson, and Shelby counties. These were the counties in which the labor troubles were the most pronounced. In Shelby County two of the larger operations were practically suspended for the entire year.

Coal was discovered in Alabama in 1834, and the United States census of 1840 reported a production of 946 tons for that year. The census of 1860 reported an output of 10,200 short tons. While it is known that a considerable amount was produced in the State before and during the civil war, the United States census of 1870 reported a production in the State of only 11,000 tons. The real development of the coal mines of Alabama began in 1881 and 1882 with the discovery of large and valuable iron-ore deposits in the vicinity of Birmingham. The Birmingham "boom" which followed was one of the first and one of the most sensational occurrences of the kind ever experienced in this country. The coal production jumped from 420,000 tons in 1881 to 896,000 tons in 1882, and to 1,568,000 tons in 1883. In 1885 it reached a total of 2,492,000 tons. Then came the reaction and the collapse of the boom with a decrease in coal production for 1886 to 1,800,000 tons. After two years of "liquidation" conditions settled down to a conservative and rational basis, and since 1888 the coal-mining industry of Alabama has developed rapidly with few and unimportant relapses. This is shown in the following table. The production for most of the earlier years (from 1840 to 1869) has been estimated.

Annual coal production of Alabama, 1840–1904.

Year.	Quantity.	Year.	Quantity.
	Short tons.		*Short tons.*
1840 [a]	946	1873	44,800
1841	1,000	1874	50,400
1842	1,000	1875	67,200
1843	1,200	1876	112,000
1844	1,200	1877	196,000
1845	1,500	1878	224,000
1846	1,500	1879	280,000
1847	2,000	1880 [a]	323,972
1848	2,000	1881	420,000
1849	2,500	1882	896,000
1850	2,500	1883	1,568,000
1851	3,000	1884	2,240,000
1852	3,000	1885	2,492,000
1853	4,000	1886	1,800,000
1854	4,500	1887	1,950,000
1855	6,000	1888	2,900,000
1856	6,800	1889	3,572,983
1857	8,000	1890	4,090,409
1858	8,500	1891	4,759,781
1859	9,000	1892	5,529,312
1860 [a]	10,200	1893	5,136,935
1861	10,000	1894	4,397,178
1862	12,500	1895	5,693,775
1863	15,000	1896	5,748,697
1864	15,000	1897	5,893,770
1865	12,000	1898	6,535,283
1866	12,000	1899	7,593,416
1867	10,000	1900	8,394,275
1868	10,000	1901	9,099,052
1869	10,000	1902	10,354,570
1870 [a]	11,000	1903	11,654,324
1871	15,000	1904	11,262,046
1872	16,800		

[a] United States census fiscal year.

ALASKA.[a]

The known coal fields of Alaska include about 16,000 square miles, but as less than one-fifth of the Territory has been surveyed, it is fair to assume that they actually embrace several times this area. Geographically the coal fields fall into four groups: (1) Those of the Pacific seaboard, (2) those of the Bering seaboard, (3) those lying near the Arctic Ocean, and (4) those of the Yukon Basin. In addition to these there are known to be extensive areas of coal-bearing rocks in the arctic slope region, as well as in other parts of the interior, but as these have only remote commercial value they need not here be considered.

The coal fields of the Pacific seaboard, though relatively small in area, are of importance, both because of their accessibility and because

[a] By Alfred H. Brooks.

they include the highest grade coal yet found in the Territory. There are two distinct types of coal in this province, both probably of Tertiary age. The lignitic coals are the most widely distributed, having been found on Admiralty Island, where little mining has been done, at various places along the shores of Cook Inlet in the Alaska Peninsula, and in the Sushitna Basin. All these lignites are probably of the same horizon (Eocene), and they occur in seams from 2 to 20 feet in thickness.

A second type of coal, which has been found in at least two localities, is of a bituminous and semianthracitic character. This high-grade fuel occurs in a series of rocks covering at least 120 square miles in the basin of Bering River which empties into Controller Bay.[a] A coal of similar character, which is probably of the same age, has been found in the valley of the Matanuska River. In both fields seams have been found up to a thickness of 30 feet. The Controller Bay coal lies within 25 miles of tidewater and about 100 miles from a good harbor on Prince William Sound, while the Matanuska coal, to which a railway is under construction, is about 30 miles from tidewater and 150 miles from Resurrection Bay, a good harbor. Both these harbors are open to navigation throughout the year.

So far as known the coals of the Bering region are chiefly lignitic; the largest fields are in valleys tributary to Norton Sound. This field would probably hardly be considered from a commercial standpoint were it not for the excellent market afforded by the placer camps of the Seward Peninsula.

Though there are probably very extensive coal fields in arctic Alaska, it is only the coals which lie near Cape Lisburne which can now be considered a commercial factor. This field,[b] embracing at least 300 square miles, lies adjacent to the arctic coast and embraces two coal-bearing horizons. The older is of Carboniferous age and includes seams of high-grade bituminous coal from 4 to 5 feet in thickness. In the younger horizon of Jurassic age have been found many commercial seams of a fair bituminous coal. Though these coals outcrop close to tidewater, their exploitation and shipment, because of the lack of a harbor and because of the shortness of the open season, will be attended with great expense. They may, however, promptly be mined at a profit to supply the demand in northern placer camps of the Seward Peninsula, where coal commands a price varying from $30 to $40 per ton in summer to $60 to $80 per ton in winter.

The coal fields of the Yukon Basin, which are at present accessible, fall into two groups. The first includes those of the upper river,

[a] Martin, G. C., The petroleum fields of the Pacific coast and the Bering River coal fields: Bull. U. S. Geol. Survey, No. 250.

[b] Collier, Arthur J., The Cape Lisburne coal field: Bull. U. S. Geol. Survey, No. 259, p. 172–185.

which are lignitic and of Tertiary age, and occur in relatively small areas. The second group includes a belt of Cretaceous coal-bearing rocks, which have been traced for some 200 miles along the lower Yukon. These latter embrace low-grade bituminous coals which have been found in seams up to 4 feet in thickness. Though they do not compare in quality with the bituminous coals of the Pacific province, yet they have a prospective value for local use.

In spite of its extensive coal fields and of the fact that Alaska is probably paying $2,000,000 annually for fuel, coal mining has been almost entirely neglected. The total output of coal reported to the Survey in 1904 was 694 short tons, and 747 tons in 1903. These figures are probably considerably below the actual production, but the total would not exceed 2,000 tons a year.

ARKANSAS.

Total production in 1904, 2,009,451 short tons; spot value, $3,102,660.

The Arkansas coal field is located in the drainage basin of the Arkansas River, in the west-central portion of the State. It is a direct continuation eastward of the Indian Territory coal field, and extends from the western boundary line of the State, down the valley of the river, a distance of approximately 75 miles. With the exception of an arm of coal-bearing formations in the Poteau and White Oak mountains at the south, the field contracts abruptly a short distance from the Arkansas-Indian Territory line, to about 25 miles in width, and so continues to the eastern extremity.

The Arkansas coals vary from bituminous to semianthracite in character, the latter grades having a high reputation as a smokeless domestic fuel, its smokeless qualities causing it to be received with great favor in the larger cities of the Mississippi Valley. It burns with a short, hot flame, and leaves a comparatively small amount of ash. In its fracture and appearance, however, it is like many of the varieties of bituminous coal. All of the coals of the State are used for locomotive and other steam fuel, principally, and also for domestic purposes. None of them is coked at the present time, and as a usual thing, they do not possess qualities suitable for coke making.

Sebastian County, in the extreme western portion of the State, is the largest coal-producing county, about two-thirds of the entire output of the State being mined within its limits. The other coal-producing counties are, in order of importance, Franklin, Johnson, Pope, Logan, Washington, and Scott.

There were no machines reported in use in the Arkansas coal mines in 1903, nor in 1904.

The coal production of Arkansas in 1904 amounted to 2,009,451 short tons, valued at $3,102,660, against 2,229,172 short tons valued at $3,360,831 in 1903, showing a decrease in the later year of 219,721 short tons in quantity and of $258,171 in value. This is only the second time in ten years that the output in one year was less than that of the preceding one. The first exception to a steadily increasing yearly production was in 1899, when the output was shortened by labor troubles.

A combination of causes contributed to the decreased production in Arkansas during 1904. The losses were all made in Sebastian County, all the other counties showing gains over 1903. The most important factor in the lessened production from Sebastian County was the flooding of four of the larger operations resulting in the entire suspension of work at three of them for over six months, and of the other one for nearly that length of time. On June 6, after several days of heavy rain, Mines Nos. 1 and 2 of the Central Coal and Coke Company and Nos. 1 and 2 of the American Smokeless Coal Company were drowned out, and only one of them was reopened before the close of the year.

The second inducing cause of decrease in Sebastian County's production was the increased utilization of fuel oils by the railroad locomotives in Texas, which had previously formed one of the important outlets for this coal. Finally, the unusually low prices prevailing in the county during the year caused the shutting down of quite a number of small mines working on some of the thinner seams. The construction of the Midland Valley Railroad from Hoye and Greenwood, Ark., to Tulsa, Ind. T., is resulting in the opening up of a number of new mines which will eventually considerably exceed the capacity of those whose operations were suspended in 1904, but these new operations had not been completely developed and did not contribute greatly to the production in 1904.

The State was practically free from strikes in 1904, two mines only being affected during the year, and the idleness in each case was for but a brief period.

The statistics of production by counties during the last two years with the distribution of the product for consumption are shown in the following tables:

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

Coal production of Arkansas in 1904, 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	400,994	2,000	5,500	408,494	$582,703	$1.43	168	695
Johnson	210,062	2,050	5,555	217,667	392,445	1.80	175	652
Logan	30,700	3,770	830	35,300	77,461	2.19	194	115
Pope	44,053	460	6,975	51,488	168,245	3.27	189	229
Sebastian	1,174,630	24,544	35,620	1,234,794	1,780,203	1.44	158	2,820
Scott and Washington	59,720	1,068	920	61,708	101,603	1.65	194	69
Total	1,920,159	33,892	55,400	2,009,451	3,102,660	1.54	165	4,580

The statistics of labor employed in 1904 show a decided increase in the number of men as compared with 1903, but a still more decided decrease in the average working time. The number of employees increased from 4,157 in 1903 to 4,580 in 1904, while the average working time decreased from 223 days to 165 days. The average production per man in 1904 was 438.7 tons, against 536.2 in 1903 and 540.7 in 1902. The daily production per man was 2.66 in 1904, 2.4 in 1903, and 2.88 in 1902. The average number of hours to the day was eight in both years. A statement of the production of coal in Arkansas, by counties, during the last five years, with the increases and decreases in 1904 as compared with 1903, is shown in the following table:

Coal production of Arkansas, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase 1904.	Decrease 1904.
Franklin	[a] 442,466	504,946	338,013	394,884	408,494	13,610	....
Johnson			193,258	198,999	217,667	18,668	....
Logan			21,751	27,286	35,300	8,014	....
Pope			34,966	48,836	51,488	2,652	....
Sebastian	999,479	1,305,190	1,325,181	1,528,888	1,234,794	....	294,094
Other counties and small mines	6,000	6,000	30,763	[b] 30,279	61,708	31,429	....
Total	1,447,945	1,816,136	1,943,932	2,229,172	2,009,451	....	[c] 219,721

[a] Includes also production of Logan County.
[b] Includes also production of Perry County.
[c] Net decrease.

According to the United States census for 1840 a small amount of coal (220 short tons) was mined in Arkansas during that year. With the exception of 9,972 short tons mined in Missouri and 400 tons from Iowa mines, this was the only coal produced west of the Mississippi River in that year, and for the next twenty years these were the only States west of the Mississippi from which any coal production was reported. The industry in Arkansas did not develop rapidly during the earlier years, as the census of 1860 shows a production of only 200 tons, and that of 1880 a total of 14,778 short tons. During the last twenty years the production has increased rapidly, there being but four years in which a decrease in production was shown. The maximum output was attained in 1903, when a total of 2,229,172 short tons was produced. These facts are exhibited in the following table:

Annual production of coal in Arkansas, 1840–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1840	220	1892	535,558
1860	200	1893	574,763
1880	14,778	1894	512,626
1881	20,000	1895	598,322
1882	25,000	1896	675,374
1883	50,000	1897	856,190
1884	75,000	1898	1,205,479
1885	100,000	1899	843,554
1886	125,000	1900	1,447,945
1887	129,600	1901	1,816,136
1888	276,871	1902	1,943,932
1889	279,584	1903	2,229,172
1890	399,888	1904	2,009,451
1891	542,379		

CALIFORNIA.

Total production in 1904, 78,888 short tons; spot value, $375,581.

All of the coal produced in both California and Oregon is lignitic in character. There are in California a number of rather widely separated lignite areas, the chief of which being the Mount Diablo and Corral Hollow fields. The principal production is from the counties of Alameda and Contra Costa, while small amounts are mined in Kern, Monterey, Riverside, and Siskiyou counties. The Corral Hollow field is located in Alameda County, and Mount Diablo in Contra Costa County. Two other areas which have produced small amounts of coal are the Ione field, in Amador County, and a small area near Elsinore, in Riverside County. In a number of other counties coal or lignite beds have been prospected to a greater or less extent, and Butte, Del Norte, Orange, Fresno, Monterey, San Diego, and other counties have produced small amounts in the past. Some recent prospecting has been done in Fresno, Mendocino, Placer, Orange, and Trinity counties, but little encouragement is held out for any extensive development. The greatly increased production and increasing use of crude petroleum as a fuel has not encouraged the development of the coal-mining industry in California in the last few years. It is believed, however, that the recent demonstrations made at the Geological Survey Coal Testing Plant at St. Louis, and which have shown the excellent producer-gas making qualities of lignite, will create a demand for this class of fuel and greatly stimulate production in this State.

The production of lignite in California in 1904 amounted to 78,888 short tons, valued at $375,581, as compared with 104,673 short tons in 1903, valued at $294,736. This indicates a decrease in quantity of 25,785 short tons in 1904, and an increase in value of $80,845. This increase in value, in spite of the smaller production, was due to the fact that all of the product of the Tesla mine, the largest producer in the State, was shipped to Stockton and manufactured into briquettes. The value is given for the briquetted fuel. The plant at Stockton is of new construction and has a capacity of about 125 tons per day of ten hours. The briquettes produced are round convex lenzes or "boulets" weighing from 6 to 8 ounces. Asphaltic pitch from California crude petroleum is used as a binder, the reduction from the crude petroleum to pitch being done at the plant. The briquettes are compressed under very heavy pressure, and each one is dropped 25 feet to a storage bin shortly after leaving the press. So far as the writer is informed this is the only coal briquetting plant in practical operation in the United States up to the close of 1904. There are, however, a number of experimental plants in operation, and several plants are under construction or in contemplation. One of these is at Oakland and another at Pittsburg, both in California.

The decrease of production in California in 1904 was due in most part to the mines at Pittsburg being shut down awaiting the completion of the briquetting plant. In the following table is presented a statement of the coal production of California since 1889, with the distribution of the product for consumption:

Distribution of the coal product of California, 1889–1904.

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
1904	74,656	3,840	392	78,888	375,581	4.76	282	168

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 lignite. The following table shows the total production of the State since 1861:

Coal production of California, 1861–1904.

[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	87,992
1876	128,049	1898	145,888
1877	107,789	1899	160,915
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	1904	78,888

[a] United States census, fiscal year.

COLORADO.

Total production in 1904, 6,658,355 short tons; spot value, $8,751,821.

The coal-producing areas of Colorado may be divided into three groups, the Eastern, Park, and Western, the fields of which are separated by areas of great elevation and erosion. The groups are subdivided into distinct fields as follows: The Eastern group into the

Raton, Canyon City, and South Platte; the Park group into the Middle Park and Como, and the Western group into the Yampa, Grand River, and La Plata.

The coal-bearing rocks of Colorado are confined to the Upper Cretaceous Measures, and with but few exceptions all of them are found in the Laramie formation. The coal-bearing formations are found along both the eastern and western flanks of the Rocky Mountains.

The coals of Colorado embrace practically every variety of coal, from lignite to anthracite. Many of the bituminous varieties are excellent coking coals, the coke produced from them supporting important iron-making industries in different portions of the State. Nearly 20 per cent of the total output of Colorado is made into coke, and nearly all of the coal is washed before being charged into the ovens.

The coal fields of the State are described in great detail in Mineral Resources of the United States, 1892, and in the Twenty-second Annual Report of the Geological Survey, Part III. There are 16 counties in Colorado producing coal, the most important of which is Las Animas County, which produces between 40 and 45 per cent of the total output. Huerfano County, the second in importance, produces something less than 20 per cent of the total. The other counties in which coal has been produced are Arapahoe, Boulder, Delta, El Paso, Fremont, Garfield, Gunnison, Jefferson, La Plata, Larimer, Mesa, Pitkin, Rio Blanco, Routt, and Weld.

Labor troubles which kept the coal mining industry of Colorado in an unsettled condition during 1903, were considerably in evidence during 1904 also. There were apparently not so many men on strike in 1904 as in the preceding year, but the total time lost was greater, and the average time lost per man in 1904 was 125 days against 57 days in 1903. The apparently smaller number of men on strike in 1904 was due to the fact that the places of many of the strikes were filled by new men and the mines were not obliged to close down. That these new miners were not able to produce as much coal as the old men is shown by a decrease in the production of the State from 7,423,602 short tons in 1903 to 6,658,355 short tons in 1904, and by the fact that the average tonnage per man per day decreased from 3.28 in 1903 to 3.14 in 1904. In a number of cases only a portion of the regular workers were on strike and the mines were kept open with a reduced force. The average price per ton showed an advance from $1.23 to $1.31, and the total value decreased less in proportion than the product, from $9,150,943 to $8,751,821. The decrease in production was 765,247 short tons, or 10.3 per cent, while the value fell off $399,122, or 4.4 per cent.

During 1904 the number of men employed in the coal mines of Colorado was 8,123, who worked an average of 261 days as compared with 9,229 men for 245 days in 1903. In 1904 the average production per man for the year was 819.7 short tons, while the daily production per man was 3.14 tons; in 1903 the yearly production per man was 804.4 tons, and the average daily production 3.28. Of the total number of men employed in 1904, there were 2,058 at 55 mines which worked 8 hours per day, 11 mines employing 432 men worked 9 hours, and 57 mines, employing 5,583 men, worked 10 hours.

The statistics relating to the undercutting of coal by machinery show that the number of machines in use in Colorado decreased from 157 in 1903 to 125 in 1904, while the machine-mined tonnage decreased from 1,270,221 to 945,965. This decrease in the mechanical production of coal was probably due to the labor troubles previously referred to.

The production, by counties, in 1903 and 1904, with the distribution of the product for consumption, is shown in the following tables:

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]	161,690	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.

Coal production of Colorado in 1904, 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.	Number of days active.	Number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
Boulder	670,263	26,961	39,600	....	736,824	$1,198,813	$1.63	219	1,109
Delta	18,000	3,363	320	....	21,683	27,619	1.27	236	31
El Paso	208,323	33,271	6,419	....	248,013	338,311	1.36	266	371
Fremont	230,014	7,017	19,169	....	256,200	527,212	2.06	214	552
Garfield	186,264	5,329	6,952	....	198,545	242,089	1.22	218	196
Gunnison	385,299	4,042	9,918	95,286	494,545	710,357	1.44	275	444
Huerfano	1,151,606	5,450	30,849	....	1,187,905	1,754,904	1.48	277	1,363
La Plata	137,888	6,492	1,300	400	146,080	215,173	1.47	234	233
Las Animas	1,873,809	31,732	55,230	848,182	2,808,953	2,977,215	1.06	281	3,202
Mesa	22,900	3,550	....	....	26,450	36,505	1.38	194	62
Routt	....	5,568	....	....	5,568	8,603	1.55	206	17
Weld	76,788	36,157	5,917	....	118,862	202,158	1.70	223	195
Other counties [a]	232,778	7,722	11,989	152,808	405,297	506,787	1.25	280	348
Small mines	....	3,430	....	....	3,430	6,075			
Total	5,193,932	180,084	187,663	1,096,676	6,658,355	8,751,821	1.31	261	8,123

[a] Adams, Jefferson, Larimer, and Pitkin.

There were 8 of the important producing counties whose production increased in 1904, and 5 in which the output was reduced. The principal losses were sustained by Fremont, Huerfano, and Las Animas counties. These facts are shown in the following table:

Coal production of Colorado, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase, 1904.	Decrease, 1904.
Boulder	574,334	482,975	806,371	803,924	736,824	....	67,100
Delta	....	....	9,350	13,029	21,683	8,654	....
El Paso	94,334	175,979	218,549	207,797	248,013	40,216	....
Fremont	619,413	536,313	695,999	633,858	256,200	....	377,658
Garfield	141,159	173,707	207,262	176,354	198,545	22,191	....
Gunnison	432,555	397,043	364,874	436,604	494,545	57,941	....
Huerfano	854,944	918,609	1,189,313	1,319,666	1,187,905	....	131,761
Jefferson	3,000	....	....	....	129,168	129,168	....
La Plata	123,524	144,892	155,029	143,637	146,080	2,443	....
Las Animas	2,123,411	2,476,138	3,245,371	3,213,743	2,808,953	....	404,790
Pitkin	175,942	325,872	414,244	342,054	269,006	....	73,048
Routt	....	1,558	3,180	2,775	5,568	2,793	....
Weld	80,015	33,374	73,681	94,492	118,862	24,370	....
Other counties	21,733	33,555	18,220	35,669	37,003	1,334	....
Total	5,244,364	5,700,015	7,401,343	7,423,602	6,658,355	....	[a] 765,247

[a] Net decrease.

Coal mining as an industry in Colorado began in 1864, a production of 500 short tons being recorded for that year. In 1876 the production reached for the first time a total exceeding 100,000 tons, and six years later, in 1882, had reached the 1,000,000 ton mark. Since that date the increase has been almost uninterrupted, there being only three instances ten years apart (in 1884, 1894, and 1904), when the production showed a decrease of any importance, and only four altogether in thirty-five years. The largest decrease, as shown in the following table, was made in the "hard times" year of 1894:

Coal production of Colorado, 1864–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1864	500	1885	1,356,062
1865	1,200	1886	1,368,338
1866	6,400	1887	1,791,735
1867	17,000	1888	2,185,477
1868	10,500	1889	2,597,181
1869	8,000	1890	3,077,003
1870 [a]	4,500	1891	3,512,632
1871	15,600	1892	3,510,830
1872	68,540	1893	4,102,389
1873	69,997	1894	2,831,409
1874	77,372	1895	3,082,982
1875	98,838	1896	3,112,400
1876	117,666	1897	3,361,703
1877	160,000	1898	4,076,347
1878	200,630	1899	4,776,224
1879	322,732	1900	5,244,364
1880 [a]	462,747	1901	5,700,015
1881	706,744	1902	7,401,343
1882	1,061,479	1903	7,423,602
1883	1,229,593	1904	6,658,355
1884	1,130,024		

[a] United States census, fiscal year.

GEORGIA.

Total production in 1904, 383,191 short tons; spot value, $466,496.

Portions of two counties in the extreme northwestern corner of Georgia are underlain by the Coal Measures of the southern Appalachian coal fields. The Walden basin of Tennessee crosses Dade County in Georgia, and extending southwesterly becomes the Blount Mountain and Warrior basins in Alabama. The Lookout basin, a narrow outlying area extends from Etowah County in Alabama in a northeastly direction into Walker County, Ga. The total area of the coal fields in Georgia is estimated at 167 square miles, the smallest of any State coal fields, and not all of which is workable. Extensive operations are carried on in both counties, however, some of this coal being highly prized as a steam fuel and finding a ready market for bunker coal at Brunswick and other coast cities. It also makes an excellent coke, and about 30 per cent of the output each year is made into coke which is sold to the furnaces at Chattanooga and other points in Tennessee and Georgia.

The production of coal in Georgia for 1904 amounted to 383,191 short tons, valued at $466,496, against 416,951 short tons, valued at $521,459, in 1903, showing a decrease of 33,760 short tons in quantity and of $54,963 in value.

A large part of the work in the coal mines of Georgia is done by convicts leased from the State government. No machines are used in the mining of the coal. The mines are worked on a basis of a ten-hour day.

The statistics of production for the last sixteen years, with the distribution of the product for consumption, are presented in the following table:

Coal production of Georgia since 1889.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Made into coke.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*	*Short tons.*				
1889	46,131	158	15,000	164,645	225,934	$338,901	$1.50	....	....
1890	57,949	....	....	170,388	228,337	238,315	1.04	313	425
1891	15,000	1,000	5,000	150,000	171,000	256,500	1.50	312	850
1892	52,614	250	3,756	158,878	215,498	212,761	.99	277	467
1893	196,227	....	4,869	171,644	372,740	365,972	.98	342	736
1894	178,610	....	8,978	166,523	354,111	299,290	.85	304	729
1895	135,692	150	6,256	118,900	260,998	215,863	.83	312	848
1896	120,496	875	7,520	109,655	238,546	168,050	.70	303	713
1897	120,398	1,481	5,500	68,490	195,869	140,466	.72	304	469
1898	135,926	890	5,650	101,721	244,187	198,169	.81	298	504
1899	149,954	440	6,150	76,567	233,111	233,344	1.00	302	567
1900	160,889	1,305	6,895	146,468	315,557	370,022	1.17	278	597
1901	249,581	550	1,930	90,764	342,825	411,685	1.20	291	766
1902	278,847	1,700	3,080	130,456	414,083	589,018	1.42	312	755
1903	267,369	812	2,218	146,552	416,951	521,459	1.25	298	681
1904	243,244	1,000	6,677	132,270	383,191	466,496	1.22	222	881

The Eighth United States Census contains the first authentic statement of production of coal in Georgia. This report, which is for 1860, gives the production in that year as 1,900 short tons. The census for 1870 does not mention any production in Georgia for that year. The Tenth Census (1880) reports an output of coal for the State of 154,644 short tons, since which time the production has been reported in Mineral Resources of the United States, as shown in the following table. The statistics for the years 1861 to 1879, inclusive, have been estimated by the writer.

Coal production of Georgia, 1860–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1860	1,900	1883	155,000
1861	2,500	1884	150,000
1862	3,500	1885	150,000
1863	6,000	1886	223,000
1864	10,000	1887	313,715
1865	10,000	1888	180,000
1866	8,000	1889	225,934
1867	8,000	1890	228,337
1868	10,000	1891	171,000
1869	12,000	1892	215,498
1870	15,000	1893	372,740
1871	20,000	1894	354,111
1872	25,000	1895	260,998
1873	40,000	1896	238,546
1874	60,000	1897	195,869
1875	80,000	1898	244,187
1876	110,000	1899	233,111
1877	120,000	1900	315,557
1878	128,000	1901	342,825
1879	140,000	1902	414,083
1880	154,644	1903	416,951
1881	168,000	1904	383,191
1882	160,000		

IDAHO.

Total production in 1904, 3,330 short tons; spot value, $12,230.

The only coal areas of Idaho from which any production has been obtained are found in the Horseshoe Bend and the Jerusalem districts, occupying the lower portion of a ridge between the Boise and Payette rivers, in front of the Boise Mountains. In the Horseshoe Bend district there is one seam of high-grade lignite of about three feet in thickness. The Jerusalem district, which contains four different seams averaging from three to eight feet in thickness, also contains lignite of about the same character as that of the Horseshoe Bend district. The largest seam is very impure. There are two other occurrences of coal in the State, one near Salmon City; the other at the eastern edge of the State where the Sublette field of Wyoming extends across the line. No mining is carried on in either of these districts at the present time.

The production from the Horseshoe Bend and Jerusalem districts has been very irregular, never reaching any commercial importance. The total production of the State in 1904 was 3,330 short tons, valued at $12,230, against 4,250 tons, worth $13,250 in 1903, and 2,030 tons, valued at $5,180 in 1902. No production was reported from the State in 1901, only 10 tons in 1900, and 20 tons in 1899.

ILLINOIS.

Total production in 1904, 36,475,060 short tons; spot value, $39,941,993.

The coal fields of Illinois are included in the Central coal field, which underlies the larger part of Illinois, the southwestern part of Indiana, and several counties of western Kentucky. Nearly three-fourths of the entire State are underlain by productive coal measures, the total area being estimated at 42,900 square miles, or nearly three-fourths of the entire Central coal field. It is the largest coal-bearing area reported for any one State of the Union, and there are more counties in Illinois in which coal is produced than in any other of the United States, the production in 1904 being reported from 51 counties.

The coals are all of the Carboniferous age, and all are of the bituminous variety, and mostly noncoking.

The Geological Survey of Illinois divides the workable coals into six different beds designated as Nos. 2, 3, 4, 5, 6, and 7, but they have never been accurately correlated, so that the use of a certain number at one locality by no means identifies it with the same number at another point. The actual number of workable seams may be more or less than is given in the reports of the State Survey.

Illinois ranks second among the coal-producing States, having held that position uninterruptedly for twenty-two years, or since it permanently supplanted Ohio in 1883.

The banner year in the production of coal in Illinois, as for a large number of other States, was in 1903, when the production amounted to 36,957,104 short tons, valued at $43,196,809. In 1904 the production amounted to 36,475,060 short tons, valued at $39,941,993, which, compared with the preceding year, shows a decrease of 482,044 short tons, or 1.3 per cent, in quantity, and of $3,254,816, or 7.5 per cent. The decrease in production, with the greater proportionate falling off in value, may be attributed to the general but not unhealthy reaction from the abnormal conditions which existed in 1903, and also to the somewhat lessened activity which marked the iron trade during last year. There were a large number of strikes among the coal workers in 1904, no less than 147 mines having been reported as being idle at one time or another during the year. In nearly every case, however, the suspension was for a very brief period, 120 cases being reported where the time lost was less than 10 days; and while 16,983 men out of a total for the State of 54,685 were on strike, the total working time lost was only 156,528 days—less than an average of 10 days to the man, and less than 1.5 per cent of the total time made. It may hardly be said, then, that the labor disturbances had any influence on the production for the year.

In spite of the decreased production the total number of employees shows an increase from 50,596 in 1903 to 54,685 in 1904, while the average working time fell off from 228 days to 213 days. From this it is found that the average production for each employee in 1904 was 667 against 731 in 1903, and that the average daily production per man decreased from 3.21 tons to 3.13 tons. In 1902 the yearly tonnage per man was 695, and the daily tonnage 3.08.

The results of the efforts made by the United Mine Workers of America, which originated in Illinois and has its greatest strength in that State, for an 8-hour day are shown in the fact that 99 per cent of the employees in the mines that reported the number of working days in Illinois worked 8 hours a day in 1904. Of the total number of mines reporting to the Survey for last year, 547, which employed altogether 53,500 men worked 8 hours; 17 mines employing 121 men worked 9 hours, and 10 mines with 52 men worked 10 hours. There were 15 mines with a total of 210 men that reported either 5, 6, or 7 hours a day.

The returns for 1904 show that there was an increase in the number of mining machines in use, and a slight decrease in the machine-mined tonnage as compared with 1903. In 1904 there were 643 machines used in the production of 7,110,902 short tons, while in 1903, 7,381,027 tons were mined by the use of 553 machines. Of the total number of machines in use in 1904, 541 were of the pick or puncher type, and 102 were chain-breast machines. No long-wall machines were used.

The production of coal in Illinois, by counties, in 1903 and 1904, with the distribution of the product for consumption, is shown in the following tables:

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	211,933	1.73	81	651

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.*				
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
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	203	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	50,596

[a] Bond, Calhoun, Cass, Greene, Hamilton, Jefferson, Kankakee, Macon, Morgan, Wabash, and Woodford.

Coal production of Illinois in 1904, 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	1,687,434	60,639	73,794	....	1,821,867	$2,806,353	$1.54	240	4,515
Christian	724,241	69,876	44,826	....	838,943	936,610	1.12	177	1,433
Clinton	804,801	19,918	30,000	....	854,719	815,115	.95	227	1,165
Fulton	1,152,999	62,964	31,252	....	1,247,215	1,512,006	1.21	210	2,059
Gallatin	61,491	21,050	2,700	7,667	92,908	95,753	1.03	183	162
Grundy	1,237,961	48,880	47,581	....	1,334,422	1,971,659	1.48	200	3,413
Henry	61,886	84,424	2,949	....	149,259	231,146	1.55	211	322

Coal production of Illinois in 1904, 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.*				
Jackson	731,559	103,664	54,384	....	889,607	$1,139,792	$1.29	197	1,136
Knox	21,178	50,775	1,853	....	73,806	115,935	1.57	191	198
Lasalle	1,233,802	259,572	49,144	....	1,542,518	2,317,824	1.50	239	3,466
Livingston	129,959	50,548	6,131	....	186,638	295,305	1.58	201	362
Logan	303,660	32,024	14,353	....	350,037	334,235	.95	207	455
McDonough	15,604	10,151	456	....	26,211	44,590	1.70	198	109
McLean	63,253	121,056	14,204	....	198,513	320,760	1.62	245	432
Macon	58,576	116,775	5,500	....	180,851	227,938	1.26	193	331
Macoupin	2,008,638	68,317	93,337	....	2,170,292	2,163,041	1.00	181	3,181
Madison	3,142,417	92,707	106,865	....	3,341,989	3,128,112	.94	228	3,373
Marion	825,759	136,564	48,185	....	1,010,508	970,415	.96	220	1,280
Marshall	415,304	26,751	25,669	....	467,724	734,012	1.57	255	968
Menard	404,438	40,900	18,647	....	463,985	519,762	1.12	213	757
Mercer	507,894	35,073	23,834	....	566,801	773,358	1.36	257	892
Montgomery	443,684	41,027	14,507	....	499,218	536,303	1.07	197	939
Peoria	755,611	139,709	17,102	....	912,422	1,078,515	1.18	210	1,381
Perry	1,221,817	37,898	37,247	....	1,296,962	1,242,373	.96	214	1,704
Randolph	493,265	28,621	9,579	....	531,465	529,567	1.00	186	850
Rock Island	27,170	57,025	2,024	....	86,219	140,419	1.63	193	147
St. Clair	3,156,368	147,512	113,752	....	3,417,632	2,815,370	.82	204	3,709
Saline	517,696	34,887	16,087	....	568,670	515,958	.91	204	738
Sangamon	3,752,775	314,175	152,249	....	4,219,199	3,886,816	.92	195	5,858
Schuyler	4,726	6,937	10	....	11,673	15,770	1.35	201	26
Scott	11,798	7,341	270	....	19,409	31,309	1.61	199	66
Shelby	97,699	23,136	9,011	....	129,846	202,077	1.56	191	319
Stark	8,200	18,855	602	....	27,657	47,068	1.70	186	84
Tazewell	130,812	56,451	7,628	....	194,891	229,500	1.18	237	328
Vermilion	2,581,198	172,489	38,359	....	2,792,046	3,074,225	1.10	223	3,681
Warren	....	10,734	50	....	10,784	15,793	1.46	239	18
Washington	58,562	35,707	2,800	....	97,069	91,214	.94	250	137
Will	63,703	10,906	1,929	....	76,538	108,064	1.41	189	242
Williamson	3,267,304	31,766	96,327	....	3,395,397	3,441,881	1.01	219	3,661
Other counties[a]	244,679	65,943	12,123	....	322,745	394,410	1.22	184	788
Small mines	....	56,405	....	....	56,405	91,640	......	....	....
Total	32,429,921	2,810,152	1,227,320	7,667	36,475,060	39,941,993	1.10	213	54,685

[a] Bond, Calhoun, Cass, Franklin, Greene, Hancock, Jefferson, Johnson, Morgan, and Woodford.

It would appear from the foregoing tables that up to the close of 1904 little progress has been made in the efforts to coke Illinois coals. The 23 ovens in Chicago, constructed by the Universal Fuel Company under Hemingway patents, were not in operation during 1904, and the only coke made in the State from Illinois coal was at the ovens of the Gallatin Coal and Coke Company, at Equality, Gallatin County.

Of the 51 counties in which coal was produced on a commercial scale in 1903 or 1904 there were 18 in which the output for the year exceeded that of 1903 and 33 in which a decreased tonnage was shown. The aggregate increases amounted to 1,525,397 short tons and the total decreases to 2,007,441 tons, making a net decrease of 482,044 tons. The increases and decreases, by counties, in 1904 as compared with 1903, and the production of each county during the last five years are shown in the following table:

Coal production of Illinois in 1900, 1901, 1902, 1903, and 1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase, 1904.	Decrease, 1904.
Bond	150,000	151,750	100,000	176,342	158,116	....	18,226
Brown	....	....	1,230	....	....	....	....
Bureau	1,318,784	1,594,803	1,769,642	1,846,642	1,821,867	....	24,775
Calhoun	6,300	5,923	3,000	5,300	6,500	1,200	....
Cass	....	....	....	1,768	810	....	958
Christian	622,183	616,373	936,036	1,024,392	838,943	....	185,449
Clinton	531,457	765,060	834,318	920,391	854,719	....	65,672
Fulton	602,645	654,416	953,607	1,105,930	1,247,215	141,285	....
Gallatin	5,969	4,800	30,911	72,205	92,908	20,703	....
Greene	5,220	3,808	6,000	6,639	5,986	....	653
Grundy	1,315,688	1,269,741	1,414,479	1,392,427	1,334,422	....	58,005
Hamilton	....	....	....	1,200	....	....	1,200
Hancock	1,267	6,106	13,400	7,380	7,923	543	....
Henry	72,046	89,465	138,312	156,870	149,259	....	7,611
Jackson	985,998	870,093	930,487	913,283	889,607	....	23,676
Jefferson	48,648	50,000	25,090	28,245	32,788	4,543	....
Jersey	....	....	3,520	....	....	....	....
Johnson	1,760	1,010	3,850	2,333	700	....	1,633
Kankakee	109,129	67,195	48,439	74,226	....	....	74,226
Knox	62,423	78,636	85,851	105,055	73,806	....	31,249
Lasalle	2,022,462	1,751,758	1,846,236	1,882,589	1,542,518	....	340,071
Livingston	236,872	307,267	395,083	122,773	186,638	63,865	....
Logan	156,901	161,611	268,707	469,578	350,037	....	119,541
McDonough	30,293	31,337	34,636	28,104	26,211	....	1,893
McLean	207,304	144,959	175,000	198,100	198,513	413	....
Macon	58,025	86,468	100,000	110,000	180,851	70,851	....
Macoupin	2,012,540	1,960,038	2,185,325	2,414,499	2,170,292	....	244,207
Madison	1,510,394	1,911,381	2,374,684	2,950,496	3,341,989	391,493	....
Marion	805,859	844,816	922,656	1,095,952	1,010,508	....	85,444
Marshall	396,087	417,444	458,186	479,641	467,724	....	11,917
Menard	397,077	390,931	471,958	483,447	463,985	....	19,462
Mercer	564,247	563,350	640,141	642,746	566,801	....	75,945
Montgomery	304,200	367,326	619,448	458,987	499,218	40,231	....
Morgan	4,500	3,000	4,780	4,358	4,737	379	....
Peoria	717,939	659,701	852,375	958,982	912,422	....	46,560
Perry	561,091	632,039	991,344	1,236,368	1,296,962	60,594	....
Randolph	466,547	368,951	456,984	535,895	531,465	....	4,430
Rock Island	44,078	68,356	83,418	69,641	86,219	16,578	....
St. Clair	2,232,786	2,298,843	2,822,248	3,464,069	3,417,632	....	46,437
Saline	116,650	163,584	297,571	433,328	568,670	135,342	....
Sangamon	2,738,402	3,277,939	4,172,722	4,470,962	4,219,199	....	251,763

Coal production of Illinois in 1900, 1901, 1902, 1903, and 1904, by counties—Continued.

County.	1900.	1901.	1902.	1903.	1904.	Increase, 1904.	Decrease, 1904.
Schuyler	4,992	5,552	18,457	12,927	11,673	....	1,254
Scott	27,097	23,680	27,435	24,776	19,409	....	5,367
Shelby	109,392	114,192	87,112	108,508	129,846	21,338	....
Stark	15,191	13,400	29,043	43,166	27,657	....	15,509
Tazewell	92,843	145,569	173,018	253,653	194,891	....	58,762
Vermilion	2,139,474	2,260,964	2,585,291	2,955,071	2,792,046	....	163,025
Warren	12,019	10,300	16,077	14,989	10,784	....	4,205
Washington	37,291	25,700	56,835	91,766	97,069	5,303	....
Will	55,323	56,646	40,792	49,240	76,538	27,298	....
Williamson	1,508,453	1,743,052	2,325,942	2,881,653	3,395,397	513,744	....
Woodford	192,135	142,219	101,567	[a] 123,501	[b] 105,185	....	18,316
Small mines	150,000	150,000	6,130	46,711	56,405	9,694	....
Total	25,767,981	27,331,552	32,939,373	36,957,104	36,475,060	....	[c] 482,044

[a] Includes production of Wabash County.
[b] Includes production of Franklin County.
[c] Net decrease.

Probably the earliest mention of coal in the United States is contained in the journal of Father Hennepin, a French missionary, who as early as 1679 reported a "cole" mine on the Illinois River above Fort Crevecoeur, near the site of the present city of Ottawa. Father Hennepin marked the location of the occurrence on the map which illustrates his journal. It is also probable that outside of anthracite mining in Pennsylvania and the operations in the Richmond basin of Virginia Illinois holds the record for priority in production. The earliest statement that we have in regard to actual mining in Illinois is that coal was produced 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 table following shows the statistics of coal production in Illinois from 1833 to 1904, inclusive, and for the years for which there is no special information the production has been estimated by the writer.

Coal production of Illinois, 1833–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1833	6,000	1869	1,854,000
1834	7,500	1870 [a]	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 [a]	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	1904	36,475,060

[a] United States census, fiscal year.

INDIANA.

Total production in 1904, 10,934,379 short tons; spot value, $12,105,709.

The eastern extremity of the central coal field underlies the southwestern portion of Indiana, the total area within the State embracing 6,500 square miles and underlying all or portions of 26 different counties, in 18 of which coal is produced upon a commercial scale. As in Illinois, all of the coal measures are of Carboniferous age, and also, as in Illinois, little reliance can be placed upon the correlations of the beds found in different portions of the State. Coal has been found in at least 20 horizons, and as many as 17 beds have been passed through in a single drilling within a vertical distance of 800 feet. Most of these are thin, but beds of sufficient thickness to be worked are found in 8 different horizons, although as a rule not more than 3 are workable at any one point. There are large areas within the boundaries of the coal field which are not underlain by workable coal. All of the coal produced in Indiana is classed as bituminous, and like the coals in Illinois they are for the greater part noncoking. The eastern portion of the field is noted for its production of "Brazil" block, which is in favor as a domestic and steam fuel. This coal derives its name from the almost perfectly rectangular blocks into which it naturally breaks, because of the pronounced cleavage planes which intersect each other at right angles. A small amount of cannel coal is also produced in the State.

Indiana was one of the nine States whose coal production in 1904 exceeded that of 1903. Compared with the preceding year the production in 1904 exhibits an increase of 139,687 short tons, the output for the two years being, in 1903, 10,794,692 short tons, and in 1904, 10,934,379 short tons. The output obtained from Indiana in 1904 was the largest in the history of the State. The increased production, however, in 1904 was obtained at a considerable sacrifice in value, as the average price declined from $1.23 in 1903 to $1.11 in 1904, and the total value of the product exhibited a decrease of $1,139,108, or 3.6 per cent.

There were employed in the coal mines of Indiana during 1904 a total of 19,707 men who worked an average of 177 days each, as compared with 17,017 men for an average of 197 days in 1903. The large increase in the number of employees in 1904 resulted in a decrease in the average tonnage per man for each day and for the year. In 1903 the 17,017 men employed produced an average of 634.3 tons each, while in 1904 the yearly tonnage per man was only 554.8. The average daily tonnage per man in 1903 was 3.22, while in 1904 it was 3.14. In 1902 the average daily production per man was 2.98, and the average yearly production was 611.1 tons.

The entire coal-mining industry of Indiana might almost be said to be on an 8-hour basis. During 1904, out of the 19,707 men employed, there were 18,727 employed in 244 mines which were worked 8 hours a day. Seven mines, employing 44 men, worked 9 hours, and 4 mines, employing 16 men, worked 10 hours. There were 7 mines, employing a total of 36 men, that were operated less than 8 hours a day, and 1 mine, with 9 men, worked 11 hours.

About one-third of the total coal product of Indiana in 1904 was undercut by the use of mining machines. The product won by the use of mining machines amounted, in 1904, to 3,681,032 short tons, as against 3,334,961 short tons of machine-mined coal in 1903. The number of machines in use increased from 329 in 1903 to 409 in 1904.

The statistics of production in Indiana in 1903 and 1904, by counties, with the distribution of the product for consumption, are shown in the following tables:

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	193
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	39,148	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

Coal production of Indiana in 1904, by counties.

County.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
Clay	876,727	38,391	44,976	960,094	$1,359,356	$1.42	172	2,631
Daviess	116,516	26,639	722	143,877	183,539	1.28	202	318
Dubois and Martin	2,500	11,168	165	13,833	17,325	1.25	164	40
Fountain	35,598	5,854	....	41,452	53,019	1.28	251	88
Gibson	77,058	15,290	5,909	98,257	101,160	1.03	173	220
Greene	2,423,473	53,959	55,178	2,532,610	2,791,879	1.10	178	3,564
Knox	140,597	28,404	4,405	173,406	170,756	.98	125	389
Parke	864,507	21,428	38,066	924,001	1,366,464	1.48	188	2,034
Perry	10,396	15,429	393	26,218	37,029	1.41	174	68
Pike	370,910	29,508	7,973	408,391	441,357	1.08	139	1,004
Spencer	3,754	13,757	....	17,511	22,185	1.27	208	42
Sullivan	1,919,041	74,823	67,348	2,061,212	2,143,185	1.04	159	3,786
Vanderburg	85,021	164,238	8,995	258,254	275,579	1.07	221	385
Vermilion	1,041,716	6,719	19,992	1,068,427	941,726	.88	176	1,563
Vigo	1,638,664	68,172	49,414	1,756,250	1,783,961	1.01	200	3,048
Warren	....	6,545	....	6,545	13,230	2.02	229	17
Warrick	365,032	45,133	6,146	416,311	367,235	.88	186	510
Small mines	....	27,730	....	27,730	36,724	......	....	....
Total	9,971,510	653,187	309,682	10,934,379	12,105,709	1.11	177	19,707

The most active development in the coal fields of Indiana during the last few years has been made in the counties of Greene and Sullivan, and these two now rank first among the coal-producing counties of the State. During the last six years Greene County has increased each year, the production having grown from 681,799 tons in 1899 to 2,532,610 tons in 1904, and Sullivan County's production has increased from 752,734 tons in 1899 to 2,061,212 tons in 1904. The production of Greene County in 1904 increased 229,098 tons, or nearly 10 per cent over 1903, and Sullivan County's production in 1904 shows an increase of 272,854 short tons, or a little over 15 per cent compared with 1903. Vermilion County also showed a substantial increase of 153,256 tons, or over 16 per cent, while the formerly principal producers of Clay and Vigo counties each showed a reduced production in 1904. Clay County's production fell off from 1,242,958 tons to 960,094 tons in 1904, a decrease of 282,864 short tons, or nearly 23 per cent. Vigo County decreased 70,143 short tons, or not quite 4 per cent.

The following table shows the coal production of Indiana, by counties, during the last five years, with the increases and decreases in 1904 as compared with 1903:

Coal production of Indiana, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase, 1904.	Decrease, 1904.
Clay	1,165,302	1,080,164	1,315,046	1,242,958	960,094	....	282,864
Daviess	a 276,625	a 238,699	234,983	183,692	143,877	....	39,815
Dubois	....	....	10,094	a 8,546	a 13,833	5,287	....
Fountain	44,232	34,826	17,099	18,660	41,452	22,792	....
Gibson	66,889	116,526	105,468	81,946	98,257	16,311	....
Greene	723,255	944,621	1,663,785	2,303,512	2,532,610	229,098	....
Knox	60,749	94,579	119,225	177,046	173,406	....	3,640
Parke	649,665	631,032	1,155,457	989,983	924,001	....	65,982
Perry	24,077	16,822	21,577	24,941	26,218	1,277	....
Pike	245,433	269,268	510,017	505,564	408,391	....	97,173
Spencer	9,106	18,885	16,274	19,948	17,511	....	2,437
Sullivan	939,989	910,725	1,268,945	1,788,358	2,061,212	272,854	....
Vanderburg	192,532	193,716	218,112	241,088	258,254	17,166	....
Vermilion	649,525	684,253	718,102	915,171	1,068,427	153,256	....
Vigo	1,151,643	1,362,041	1,652,798	1,826,393	1,756,250	....	70,143
Warren	....	....	3,380	5,250	6,545	1,295	....
Warrick	249,064	286,068	416,062	435,797	416,311	....	19,486
Small mines	36,000	36,000	(a)	25,839	27,730	1,891	....
Total	6,484,086	6,918,225	9,446,424	10,794,692	10,934,379	b 139,687	....

a Includes Martin County. b Net increase.

The United States census for 1840 reports a production of coal in Indiana for that year of 9,682 tons. The census for 1850 did not include any investigation of the mining industry, and the next official statistics are for the year 1860, when the census reported a production of 101,280 short tons. Ten years later the census for 1870 reported a production of 437,870 short tons. In the following table, which shows the production of coal in Indiana since 1840, the production for the years for which no official statistics are available have been estimated by the writer:

Production of coal in Indiana, 1840–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1840 *a*	9,682	1873	1,000,000
1841	10,000	1874	812,000
1842	18,000	1875	800,000
1843	25,000	1876	950,000
1844	30,000	1877	1,000,000
1845	35,000	1878	1,000,000
1846	40,000	1879	1,196,490
1847	45,000	1880 *a*	1,454,327
1848	50,000	1881	1,984,120
1849	56,000	1882	1,976,470
1850	60,000	1883	2,560,000
1851	60,000	1884	2,260,000
1852	75,000	1885	2,375,000
1853	75,000	1886	3,000,000
1854	80,000	1887	3,217,711
1855	80,000	1888	3,140,979
1856	85,000	1889	2,845,057
1857	85,000	1890	3,305,737
1858	87,000	1891	2,973,474
1859	95,000	1892	3,345,174
1860 *a*	101,280	1893	3,791,851
1861	128,000	1894	3,423,921
1862	150,000	1895	3,995,892
1863	200,000	1896	3,905,779
1864	250,000	1897	4,151,169
1865	280,000	1898	4,920,743
1866	320,000	1899	6,006,523
1867	350,000	1900	6,484,086
1868	375,000	1901	6,918,225
1869	400,000	1902	9,446,424
1870 *a*	437,870	1903	10,794,692
1871	600,000	1904	10,934,379
1872	896,000		

a United States census, fiscal year.

INDIAN TERRITORY.

Total production in 1904, 3,046,539 short tons; spot value, $5,532,066.

The coal areas of the Indian Territory form a portion of the western coal field and are directly connected with the Kansas field on the north and the Arkansas field on the east. Within the Territory this field has an area of approximately 20,000 square miles underlying the western half of the Cherokee Nation, the whole of the Creek Nation, the northern third of the Choctaw Nation, and a small portion of the Chickasaw Nation.

The coal-bearing areas of the Territory belong to the Coal Measures of the Carboniferous age. They vary from the bituminous to the semianthracite, and some of the bituminous varieties possess coking qualities, and some coal is coked each year from slack produced in the mining operations. Practically all of the coal coked is washed before being used.

The greater portion of the development in the Territory has been in the Choctaw Nation, in the area tributary to the Missouri, Kansas and Texas Railway, and the St. Louis and San Francisco Railroad, which cross the Territory from north to south, and to the Choctaw, Oklahoma and Gulf Railroad, which crosses it from east to west.

The total area underlain by workable seams is estimated to contain 14,848 square miles. At present the entire production is from the Cherokee, Creek, and Choctaw nations, the latter of which contributes by far the greater portion.

Conditions affecting the coal-mining industry in Arkansas influence likewise that of the Indian Territory. To the increased production and use of fuel oil in Texas may be ascribed in part the decreased output of coal in both Arkansas and the Indian Territory during 1904. The production in Arkansas decreased from 2,229,172 short tons in 1903 to 2,009,451 short tons in 1904. That of the Territory fell off from 3,517,388 short tons to 3,046,539 short tons, a decrease of 470,849 short tons, or 13.4 per cent. The value of the Territory's product decreased in the same proportion from $6,386,463 to $5,532,066, a loss of $854,397. Labor troubles occurred in only 4 mines in the Territory during the year, and these were not of sufficient importance to affect the total production for the year. In the 4 mines in which strikes occurred a total of 488 men were employed. Two of the strikes were settled after 3 days of idleness, and the average time lost was only 11 days per man at all 4 mines.

Labor statistics for the coal mines of the Territory in 1904 show a total of 8,487 men employed for an average of 199 days per man, against 7,704 men for 247 days in 1903. These figures show that there was also a falling off in the "intensity of labor" in 1904, for the average production per man during the year was 359.9 tons and the daily production 1.80, whereas in 1903 the average tonnage per man for the year was 457, and the average daily tonnage per man 1.85. In 1902 the average tonnage per man for the year was 506, and for each day 2.18. Most of the mines worked on an eight hour per day basis, 59 mines with 8,251 employees working eight hours. Two mines, employing 95 men, worked nine hours, and 2 mines, employing 75 men, worked ten hours. There has been a steady decline in the use of mining machines in the Territory since 1899, when over a quarter of a million tons, or more than one-sixth of the total production of the Territory, was undercut by machines. In 1904 the total number of machines reported in use was 18, and the machine-mined production amounted to only 42,594 short tons, or 1.4 per cent of the total.

Distribution of the coal product of Indian Territory, 1891–1904.

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	1,173,899	3,070	21,935	12,781	1,211,185	1,737,254	1.43	164	3,212
1896	1,295,742	12,648	45,560	12,696	1,366,646	1,918,115	1.40	170	3,549
1897	1,250,066	9,068	47,501	29,745	1,336,380	1,787,358	1.34	176	3,168
1898	1,310,178	16,632	34,055	20,601	1,381,466	1,827,638	1.32	198	3,216
1899	1,444,063	12,280	54,222	26,862	1,537,427	2,199,785	1.43	212	4,084
1900	1,796,422	14,786	54,137	56,953	1,922,298	2,788,124	1.45	228	4,525
1901	2,249,100	31,370	83,183	58,128	2,421,781	3,915,268	1.62	208	6,706
1902	2,587,100	25,998	96,017	111,551	2,820,666	4,265,106	1.51	232	5,574
1903	3,329,610	32,610	78,995	76,173	3,517,388	6,386,463	1.82	247	7,704
1904	2,823,484	35,512	122,266	65,277	3,046,539	5,532,066	1.82	199	8,487

The Tenth United States Census (1880) contains the first published record of the production of coal in the Indian Territory, although as a small amount of coal was mined in Arkansas as early as 1840, it is probable that some was produced in the Territory earlier than 1880. The completion of the Choctaw, Oklahoma and Gulf Railroad about 1888 and the opening up of the mines along its line gave an added impetus to the industry, the growth of which is shown in the table following.

Production of coal in Indian Territory, 1880–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1880 [a]	120,947	1893	1,252,110
1881	150,000	1894	969,606
1882	200,000	1895	1,211,185
1883	350,000	1896	1,366,646
1834	425,000	1897	1,336,380
1885	500,000	1898	1,381,466
1886	534,580	1899	1,537,427
1887	685,911	1900	1,922,298
1888	761,986	1901	2,421,781
1889	752,832	1902	2,820,666
1890	869,229	1903	3,517,388
1891	1,091,032	1904	3,046,539
1892	1,192,721		

[a] United States census, fiscal year.

IOWA.

Total production in 1904, 6,519,933 short tons; spot value, $10,504,406.

The coal fields of Iowa occupy the south central and southwestern portions of the State. They include an area of approximately 20,000 square miles of which 10,000 may be considered probably productive territory. The beds belong to the Pennsylvanian series of the Carboniferous and include shales, sandstones, limestones, and coal. There are two well-recognized divisions, of which the lower, locally known as the Des Moines formation, is the more productive. In this formation the sandstones are thick and abundant, the shales are largely arenaceous and bituminous, and the coal seams while thick are, with one exception, very irregularly distributed. In the upper portion of the formation certain thin limestones appear, and associated with them is a coal known as the Mystic or Centerville block which extends, with great regularity, through a considerable area in Appanoose and Wayne counties.

The Upper Coal Measures or Missourian formation consist largely of limestones and calcareous clays and carry only one coal bed of any importance. This is a 20-inch bed mined locally in Adams, Taylor, and Page counties. The Coal Measures as a whole have a dip of 10 to 20 feet to the mile to the southwest and increase in thickness from their outcrop to a maximum of approximately 1,000 feet. The coal is of the dry, noncoking bituminous variety. The more important productive areas are, (1) the northern, including Webster, Boone, and adjacent counties, and yielding approximately 7 per cent of the total output; (2) the north central including Polk and Jasper counties, and yielding

20 per cent of the output; (3) the south central, including Monroe, Wapello, Mahaska, Marion, and adjacent counties, and contributing more than 50 per cent of the total output; (4) the southern district, including Appanoose and Wayne counties, and yielding 16 per cent of the output from the coal seam already mentioned.

Iowa is one of the 9 States whose production in 1904 exhibits an increase over the preceding year. The total output in 1904 was 6,519,933 short tons against 6,419,811 tons in 1903, an increase of 100,122 tons. With a decline in the average price per ton, however, from $1.65 to $1.61 the total value shows a decrease from $10,563,910 to $10,504,406, a loss of $59,504. The production would probably have shown a larger increase but for strikes, of which there were no less than 68 (counting suspension at each mine a separate strike) during 1904. Most of them were of short duration, lasting from 15 to 25 days. More than half of the total number of men employed, 8,303 out of 15,629 were idle at one time or another because of strikes, but the total time lost amounted to only 173,781 working days, an average of 21 for each man idle, and equivalent to not quite 5 per cent of the total working time made during the year.

There was an increase in the total number of employees from 14,162 in 1903 to 15,629 in 1904, but the average working time fell off from 226 days to 213 days, which about represented the time lost by strikes. From these figures it appears that the average production for each man employed was 417.2 tons in 1904 against 453.3 tons in 1903. In 1902 the average production per man was 475 tons. The average daily production per man was nearly the same in both years, 2 tons in 1903 and 1.96 in 1904 against 2.09 in 1902.

With few exceptions the coal miners of Iowa worked on a basis of an 8-hour day. Out of the total of 15,629 men, 15,221, distributed among 261 mines, worked 8 hours. One mine having 10 men reported 9 hours for the working day, and one other, also employing 10 men, worked 10 hours. Four others, with a total of 25 men, reported 7 hours as the length of the working day. The number of hours made by the other 363 men was not reported.

More tonnage was reported as mined by machines in Iowa during 1904 than in the two preceding years combined. Altogether there were 39 machines in use, and the production by machines amounted to 175,742 short tons, as compared with 10 machines and 55,085 tons in 1903, and 31 machines and 110,489 tons in 1902.

The statistics of production in 1903 and 1904, with the distribution of the product for consumption, are shown in the following tables:

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
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

Coal production of Iowa in 1904, 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	....	12,960	10	12,970	$30,645	$2.36	162	90
Appanoose	825,014	35,167	12,739	872,920	1,644,164	1.88	188	2,774
Boone	259,017	20,370	5,770	285,157	558,279	1.96	194	1,029
Dallas	6,100	6,400	586	13,086	28,149	2.15	148	44
Greene	90	26,434	1,180	27,704	57,009	2.06	183	75
Guthrie	....	11,949	....	11,949	32,707	2.74	162	48
Jasper	236,594	10,044	11,460	258,098	374,906	1.45	217	573
Jefferson	2,580	6,980	250	9,810	20,232	2.06	173	26
Keokuk	21,769	16,827	2,916	41,512	61,843	1.49	239	107
Lucas	163,519	12,117	14,259	189,895	278,890	1.47	184	476
Mahaska	613,614	43,263	18,236	675,113	964,604	1.42	194	1,564
Marion	288,855	20,135	5,918	314,908	416,942	1.32	217	732
Monroe	1,898,076	44,372	45,002	1,987,450	2,907,413	1.46	240	3,875
Page	....	18,297	5	18,302	50,178	2.74	217	108
Polk	849,540	238,702	42,426	1,130,668	1,937,389	1.71	224	2,388
Scott	1,405	8,400	125	9,930	19,860	2.00	169	49
Taylor	8,952	7,286	35	16,273	37,838	2.32	200	68
Van Buren	4,721	3,284	....	8,005	16,301	2.04	207	29
Wapello	272,514	101,050	5,996	379,560	562,562	1.48	237	798
Warren	6,429	4,861	....	11,290	24,682	2.19	149	48
Wayne	86,743	12,006	130	98,879	180,176	1.82	203	383
Webster	117,363	13,470	3,705	134,538	275,725	2.05	226	345
Small mines	....	11,916	....	11,916	23,912	......	......	......
Total	5,662,895	686,290	170,748	6,519,933	10,504,406	1.61	213	15,629

The production of the State, by counties, during the last five years and the increases and decreases in 1904 as compared with 1903 are shown in the following table:

Coal production of Iowa, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase 1904.	Decrease 1904.
Adams	....	....	19,751	22,570	12,970	....	9,600
Appanoose	680,094	721,997	900,337	893,021	872,920	....	20,101
Boone	266,542	254,054	254,324	291,321	285,157	....	6,164
Dallas	16,737	16,987	18,845	15,467	13,086	....	2,381
Davis	....	....	3,953	3,160	....	....	3,160
Greene	17,044	18,810	11,573	14,971	27,704	12,733	....
Jasper	99,948	184,670	233,440	270,804	258,098	....	12,706
Jefferson	....	....	10,610	6,844	9,810	2,966	....
Keokuk	258,933	308,193	106,103	62,875	41,512	....	21,363
Lucas	227,921	221,058	246,400	295,554	189,895	....	105,659
Mahaska	1,142,017	929,110	723,567	698,166	675,113	....	23,053
Marion	186,446	145,981	315,425	324,859	314,908	....	9,951
Monroe	755,286	1,038,332	1,406,905	1,768,054	1,987,450	219,396	....
Page	....	....	10,070	16,343	18,802	1,959	....
Polk	827,482	1,025,014	1,023,860	1,032,164	1,130,668	98,504	....
Scott	....	....	10,358	12,653	9,930	....	2,723
Taylor	17,159	23,499	14,207	16,933	16,273	....	660
Van Buren	12,108	12,572	14,816	13,561	8,005	....	5,556
Wapello	276,360	312,174	340,762	382,398	379,560	....	2,838
Warren	24,724	14,661	20,127	12,760	11,290	....	1,470
Wayne	65,140	56,578	65,374	105,170	98,879	....	6,291
Webster	123,660	146,020	149,615	138,296	134,538	....	3,758
Other counties and small mines	205,338	187,789	4,344	21,867	23,865	1,998	....
Total	5,202,939	5,617,499	5,904,766	6,419,811	6,519,933	*a* 100,122	....

a Net increase.

The United States census of 1840 credits Iowa with a production of coal amounting to 400 short tons. Since that time the annual production has been as follows:

Production of coal in Iowa, 1840–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1840 *a*	400	1873	392,000
1841	500	1874	799,936
1842	750	1875	1,231,547
1843	1,000	1876	1,250,000
1844	2,500	1877	1,300,000
1845	5,000	1878	1,350,000
1846	6,500	1879	1,400,000
1847	8,000	1880	1,461,116
1848	10,000	1881	1,960,000
1849	12,500	1882	3,920,000
1850	15,000	1883	4,457,540
1851	18,000	1884	4,370,566
1852	20,000	1885	4,012,575
1853	23,000	1886	4,315,779
1854	25,000	1887	4,473,828
1855	28,000	1888	4,952,440
1856	30,000	1889	4,095,358
1857	33,000	1890	4,021,739
1858	37,500	1891	3,825,495
1859	42,000	1892	3,918,491
1860 *a*	41,920	1893	3,972,229
1861	50,000	1894	3,967,253
1862	53,000	1895	4,156,074
1863	57,000	1896	3,954,028
1864	63,000	1897	4,611,865
1865	69,574	1898	4,618,842
1866	99,320	1899	5,177,479
1867	150,000	1900	5,202,939
1868	241,453	1901	5,617,499
1869	295,105	1902	5,904,766
1870 *a*	263,487	1903	6,419,811
1871	300,000	1904	6,519,933
1872	336,000		

a United States census, fiscal year.

KANSAS.

Total production, 6,333,307 short tons; spot value, $9,640,771.

The Coal Measures of Kansas occupy the eastern portion of that State and underlie approximately 20,000 square miles, of which 15,000 have been estimated as probably more or less productive. The Coal Measures belong to the Pennsylvanian series of the Carboniferous, and include the southwestern extension of the Iowa-Missouri field. The formation differs somewhat from that of the adjacent States in that the division between the upper and lower portion is not so well marked. The limestones which in Iowa and Missouri characterize especially the upper portion of the Coal Measures are more prominent in Kansas, and coal is also found to a considerable extent in the upper beds as well as in the lower. The total thickness of the Coal Measures has been estimated at 3,000 feet. The dip is to the north and west, and the beds increase in thickness in that direction. The most important coal field in the State is that of Cherokee and Crawford counties in the southeastern corner. In this field the Cherokee bed, which varies in thickness from 3 to 10 feet, and has a general average of 40 to 42 inches, is largely mined. The coal is of better grade than that found in the adjacent States and the mining conditions as regards roof and floor are excellent. Approximately 91 per cent of the output of the State comes from these counties.

The second district of importance is that adjacent to Leavenworth and Atchison in the northeastern portion of the State, where, at a depth of 700 to 850 feet and at horizons equivalent to those mined in eastern Missouri, a thin bed of coal is found. This field yields a trifle less than 6 per cent of the total output of the State, and is notable as being the only point at which deep mining is carried on in the western interior coal field. The third important district in Kansas is that of Osage and adjacent counties in which a coal bed 20 to 22 inches thick is mined and yields approximately 3 per cent of the State's output. This bed is notable as being well up in the upper Coal Measures and stratigraphically 2,000 feet above the Cherokee coal. It occupies approximately the horizon of the seam locally mined in southwestern Iowa.

Kansas is included among the small number of States whose coal production in 1904 exhibits an increase over 1903. The statistics for 1903 credited Kansas with a production of 5,839,976 short tons, valued at $8,871,953, while in 1904 it amounted to 6,333,307 short tons, valued at $9,640,771, indicating an increase of 493,331 short tons in quantity and of $768,818 in value. This increase in production without any decline in price (the average being the same, $1.52 in both years) and in a year of generally decreased production and lower values must be considered as an evidence of prosperity and of growing industry in the State. The prices obtained for Kansas coal in 1903 and 1904 were highest of any year of which there is any record.

There were employed in the coal mines of Kansas during 1904 a total of 12,198 men who worked an average of 213 days, compared with 10,924 men for 215 days in 1903. From this it is deduced that in 1904 the average production per man for the year was 519.2 tons, while in 1903 it was 534.6 tons. The daily production per man was 2.49 tons in 1903 and 2.44 in 1904. The mines as a general thing were worked on an eight hour per day schedule in both years. In 1904, 151 mines, which gave employment to 95 per cent of the total number of miners and mine laborers, were reported as working 8 hours a day. Only 9 mines employing 215 men reported 9 hours in 1904, and 5 mines having 45 men worked 10 hours.

Troubles with labor in the coal mines of Kansas in 1904 were practicably negligible. Strikes occurred at 6 mines, but they were all settled quickly, the longest lasting 44 days, and the average time lost by the total of 186 men affected was 7 days.

A very small portion of the product in 1903 and 1904 was won with the use of mining machines, of which there were 5 in use in both years. In 1904 the machine-mined product amounted to 10,600 tons, and in 1903 it was 9,876 tons.

The statistics of production in 1903 and 1904, by counties, with the distribution of the product for consumption, are shown in the following tables:

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	33,479	33,877	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	830,701	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.

Coal production of Kansas in 1904, 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	2,292,419	43,387	42,344	474	2,378,624	$3,573,432	$1.50	209	4,053
Crawford	3,228,928	107,962	62,444	....	3,399,334	4,830,340	1.42	220	5,912
Leavenworth	201,873	118,951	12,595	....	333,419	711,097	2.13	235	1,179
Linn	25,246	3,891	520	....	29,657	52,209	1.76	170	111
Osage	152,576	18,338	540	....	171,454	422,922	2.47	179	892
Other counties [a]	2,000	7,900	540	....	10,440	28,500	2.73	156	51
Small mines	....	10,379	....	....	10,379	22,271	......	....	....
Total	5,903,042	310,808	118,983	474	6,333,307	9,640,771	1.52	213	12,198

[a] Bourbon, Cloud, Franklin, and Jewell.

The production by counties during the last five years, with the increases and decreases in 1904 as compared with 1903, is shown in the following table:

Coal production of Kansas, 1900–1904.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase, 1904.	Decrease 1904.
Atchison	2,000	3,000	([a])	....	....	....	....
Cherokee	1,547,471	1,550,198	1,849,896	2,062,897	2,378,624	315,727	....
Cloud	....	....	7,524	2,400	3,000	600	....
Crawford	2,307,130	2,708,701	2,881,274	3,132,595	3,399,334	266,739	....
Franklin	4,420	11,460	4,999	4,900	4,740	....	160
Leavenworth	250,229	248,476	291,681	382,828	333,419	....	49,409
Linn	26,640	26,380	29,780	47,617	29,657	....	17,960
Osage	196,998	222,293	192,781	194,727	171,454	....	23,273
Other counties and small mines	132,982	130,020	8,130	12,012	13,079	1,067	....
Total	4,467,870	4,900,528	5,266,065	5,839,976	6,333,307	[b] 493,331	....

[a] Included in other counties. [b] Net increase.

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 1882 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, 1869–1904.

[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	1904	6,333,307

[a] United States census, fiscal year.

KENTUCKY.

Total production in 1904, 7,566,482 short tons; spot value, $7,857,691.

Kentucky is the only one of the coal-producing States which has within its borders areas belonging to any two of the great coal fields. The eastern counties of the State are underlain by the coal beds of the great Appalachian system, extending entirely across the State in a northeast-southwest direction, while the southern limits of the central or eastern interior field are found in the more northern counties of the western part of the State. The total area underlain by coal in the eastern counties of the State is estimated at 11,180 square miles. The coal-bearing areas in the western part of the State are estimated to contain 5,800 square miles, or somewhat more than one-half of that of the eastern part of the State. Up to the close of 1904 the western district, however, produced considerably more than half the total output of the State, but the recent developments in Pike, Johnson, and other counties of the eastern portion of Kentucky lead to the impression that the production in the eastern district will soon exceed that of the western.

From the practical standpoint the eastern Kentucky coal field is a unit, unless the Middlesboro-Harlan field, cut off by the Pine Mountain fault, be excepted. The field has an area of 11,180 square miles. The great bulk of this area has at present no transportation facilities, and development has been confined to the close proximity of the few lines of railroad that cross or enter the field. Thus at the north there are about a dozen commercial mines on the Chesapeake and Ohio Railroad where it crosses Carter and Boyd counties. Lawrence, Johnson, Lee, and Breathitt counties each support a few small mines, and the Chesapeake and Ohio has nearly or quite completed a line into the Elkhorn field, which promises to become one of the most important in the State. The larger mines are mostly in the southern field. Along the Cincinnati Southern are a group of mines in Pulaski County and western Whitley County. Along the Louisville and Nashville are a detached group of mines in Laurel County and scattered mines in Knox, Bell, and Whitley counties.

The coals of this field belong to the Lower Productive Coal Measures and Pottsville formation of Pennsylvania. The latter formation, which at the Ohio River has a thickness of only a few hundred feet and carries five coals, in the southeastern corner of the State is about 5,000 feet thick and carries nearly fifty coals, of which a dozen or more are locally of workable thickness and quality. The eastern Kentucky coals are mostly high grade "gas" or "coking" coals, with some cannel coal. In the Jellico field the Jellico and Blue Gem seams are both thin, the latter being successfully mined where averaging only 22 inches. On the other hand, some of the seams show 8 and 9 feet or more of workable coal.

The workable coal of the western district of Kentucky is confined almost entirely to two beds, designated as Nos. 9 and 11 by the Kentucky Geological Survey. Of these, No. 9 is the more persistent and furnishes probably 75 per cent or more of the total production of the western counties of the State. It underlies the whole or portions of eight counties, including all of the field except its eastern portion and the southern or southwestern edge, and in a few other cases, where it has been cut out by irregularities in the structure. The bed has an average thickness of about 5 feet, and only rarely thickens out to more than 5 feet 6 inches, or thins down to less than 4 feet 6 inches. It lies, as a rule, about 200 feet below the surface, the mining being done by shaft. Seam No. 11 lies from 40 to 100 feet above No. 9, and is the next important bed in western Kentucky. It is much more irregular than No. 9, but usually where worked has a thickness of 6 feet or over. Another seam lying about 25 feet above No. 11 is known as No. 12. It is in Webster, Hopkins, McLean, and Muhlenberg counties. In the central portion of this field this bed attains a thickness of from 3 to 6 feet. Other seams besides these three are mined in the district, notably what is supposed to be No. 6 and also No. 5, near De Koven, in Union County.

Some coal was mined in the western counties of Kentucky as early as 1840, it having been reported in that year that a considerable amount of coal was shipped down the Ohio River from Union and Hancock counties, in this portion of the State. Mining in the eastern portion antedated the western field by about twelve years. It was not until 1870, however, after the close of the civil war, that the active development in the coal mines of Kentucky really began. In that year (1870) the production, as reported to the United States Census, amounted to 150,582 short tons. The census of 1860 reported a production of 285,760 short tons. Since 1870 the development has kept pace with other industrial enterprises in the Southern States.

Kentucky's coal production in 1904 amounted to 7,566,482 short tons, valued at $7,857,691, against 7,538,032 short tons, valued at $7,979,342 in 1903. Although this exhibits an increase in tonnage of less than 0.5 per cent in 1904 over the preceding year, it is sufficient to place Kentucky among the 9 States whose output last year exceeded that of 1903. There was, however, a decline in the average price per ton, which caused a decrease in the total value of $121,651.

There were employed in the coal mines of Kentucky during 1904 a total of 14,200 men, who worked an average of 197 days, as compared with 14,354 men for 207 days in 1903. Dividing the total tonnage for each year by the total number of men employed, it is seen that there was produced for each man employed in 1904 an average of 532.9 short tons, against 525.2 tons in 1903 and 493 tons in 1902. The average daily production per man in 1904 was 2.71 tons, against 2.54 in 1903 and 2.35 in 1902. The lengths of the working days in Kentucky were pretty evenly divided between 8, 9, and 10 hours, the last mentioned having the largest number both of mines and men. There were 58 mines, employing 3,870 men, that worked 8 hours; 60 mines, employing 4,208 men, that worked 9 hours, and 141 mines, employing 5,952 men, that worked 10 hours.

Nearly one-half of the total coal tonnage of Kentucky in 1904 was undercut by the use of machines, 3,595,513 short tons, or 47.5 per cent of a total of 7,566,482 tons, being machine-mined. The total number of machines in use in 1904 was 453, against 308 in 1903, when 2,843,805 tons were mined by machines.

The time lost by strikes in the coal mines of Kentucky in 1904 amounted to about 5 per cent of the total time made. Strikes occurred in 37 different mines, and a total of 3,781 men were idle for an average of 39 days each.

The statistics of production in 1903 and 1904 by counties, with the distribution of the product for consumption, are shown in the following tables:

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	61,936	1.30	208	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	1,318
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	183
Union	304,346	26,838	13,315	5,126	349,625	412,862	1.18	193	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	6,805,323	380,449	159,589	192,671	7,538,032	7,979,342	1.06	207	14,354

[a] Butler, Caldwel' Carroll, Crittenden, Floyd, Greenup, Knott, Letcher, Martin, Menifee, and Warren.

Coal production of Kentucky in 1904, 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	484,164	13,091	7,640	6,767	511,662	$549,359	$1.07	194	1,306
Boyd	69,067	....	28	....	69,095	58,304	.84	152	236
Carter	241,088	2,832	1,110	....	245,030	259,384	1.06	167	528
Daviess	....	44,125	....	....	44,125	45,741	1.03	241	83
Hancock	46,829	3,025	....	....	49,854	56,521	1.13	122	174
Henderson	91,600	54,205	5,298	....	151,103	169,010	1.12	189	278
Hopkins and Christian	1,605,812	45,755	52,991	79,060	1,783,618	1,575,592	.88	212	2,212
Johnson	36,870	2,150	2,100	....	41,120	36,080	.88	163	175
Knox	564,019	6,663	7,096	....	577,778	609,820	1.06	226	995
Laurel	369,981	4,750	5,936	....	380,667	388,758	1.02	195	800
Lee	67,298	400	250	....	67,948	86,848	1.28	201	154
McLean	105,231	11,098	1,287	....	117,616	107,363	.91	183	187
Muhlenberg	899,381	19,257	15,410	....	934,048	839,765	.90	177	1,687
Ohio	477,436	22,156	14,534	....	514,126	480,157	.93	183	1,044
Pulaski	183,822	6,154	7,820	....	197,796	248,278	1.26	216	418
Rockcastle	133,000	5,840	500	....	139,340	254,744	1.83	244	265
Union	309,642	31,717	19,557	7,278	368,194	368,685	1.00	171	706
Webster	229,132	46,900	22,683	....	298,715	295,139	.99	192	484
Whitley	738,421	40,062	10,353	....	788,836	1,064,733	1.35	194	1,873
Other counties [a]	216,454	22,278	6,377	....	245,109	316,882	1.29	215	595
Small mines	....	40,702	....	....	40,702	46,529	....	....	....
Total	6,869,247	423,160	180,970	93,105	7,566,482	7,857,691	1.04	197	14,200

[a] Breathitt, Butler, Caldwell, Clay, Grayson, Greenup, Knott, Lawrence, Letcher, Magoffin, Menifee, Morgan, Owsley, and Pike.

In the following table is presented a statement of the production of coal in Kentucky during the last five years with the increases and decreases in 1904 as compared with the preceding year:

Coal production of Kentucky, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase in 1904.	Decrease in 1904.
Bell	224,500	333,235	461,768	392,016	511,662	119,646	....
Boyd	170,931	173,930	242,021	245,491	69,095	....	176,396
Breathitt and Lee	33,416	37,326	60,524	80,301	110,303	30,002	....
Butler	32,482	18,802	12,868	3,600	1,647	....	1,953
Carter	248,756	245,526	281,401	265,226	245,030	....	20,196
Christian, Daviess, and Hancock	114,253	97,645	125,708	180,544	185,922	5,378	....
Greenup	....	....	....	3,167	2,742	....	425
Henderson	135,775	169,365	158,471	178,871	151,103	....	27,768
Hopkins	1,371,826	1,362,299	1,555,084	1,743,721	1,691,675	....	52,046
Johnson	19,164	[a] 37,692	126,473	77,100	41,120	....	35,980
Knox	303,969	283,706	481,819	543,557	577,778	34,221	....
Laurel	351,786	315,698	402,997	392,288	380,667	....	11,621
Lawrence	46,316	46,924	57,387	66,826	69,036	2,210	....
McLean	20,454	17,716	54,568	127,869	117,616	....	10,253
Muhlenberg	399,944	532,840	700,700	798,892	934,048	135,156	....
Ohio	552,665	502,974	541,226	586,072	514,126	....	71,946
Pulaski	92,960	138,787	159,497	196,287	197,796	1,509	....
Rockcastle	8,000	15,000	3,660	56,901	139,340	82,439	....
Union	268,133	277,337	315,786	349,625	368,194	18,569	....
Webster	110,565	122,116	278,042	371,560	298,715	....	72,845
Whitley	673,069	591,068	687,831	710,747	788,836	78,089	....
Other counties and small mines	150,000	150,000	59,153	167,371	170,031	2,660	....
Total	5,328,964	5,469,986	6,766,984	7,538,032	7,566,482	[b] 28,450	....

[a] Includes Morgan County. [b] Net increase.

As Kentucky's coal product is drawn from two of the great coal fields, a comparison of the two sections is of some interest. The following tables show the production in the eastern and western districts by counties during the last five years, with the increases and decreases in 1904. It will be noted that all of the increased production in 1904 was in the eastern district, the western and more important district showing a decrease of nearly 14,000 tons. Most of the labor troubles were experienced in the western district, and the decreased production in that section was due in part to this cause.

Coal production of the eastern district of Kentucky, 1900–1904.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase in 1904.	Decrease in 1904.
Bell	224,500	333,235	461,768	392,016	511,662	119,646	....
Boyd	170,931	173,930	242,021	245,491	69,095	....	176,396
Breathitt	16,416	18,540	23,873	32,730	42,355	9,625	....
Carter	248,756	245,526	281,401	265,226	245,030	....	20,196
Greenup	....	....	....	3,167	2,742	....	425
Johnson	19,164	[a] 37,692	126,473	77,100	41,120	....	35,980
Knox	303,969	283,706	481,819	543,557	577,778	34,221	....
Laurel	351,786	315,698	402,997	392,288	380,667	....	11,621
Lawrence	46,316	46,924	57,387	66,826	69,036	2,210	....
Lee	17,000	18,786	36,651	47,571	67,948	20,377	....
Pulaski	92,960	138,787	159,497	196,287	197,796	1,509	....
Rockcastle	8,000	15,000	3,660	56,901	139,340	82,439	....
Whitley	673,069	591,068	687,831	710,747	788,836	78,089	....
Other counties and small mines	....	90,000	40,000	129,065	68,013	....	61,052
Total	2,172,867	2,308,892	3,005,378	3,158,972	3,201,418	[b] 42,446	....

[a] Includes Morgan County. [b] Net increase.

Coal production of the western district of Kentucky, 1900–1904.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase in 1904.	Decrease in 1904.
Butler	32,482	18,802	12,868	3,600	1,647	....	1,953
Christian	93,931	73,220	87,353	99,226	91,943	....	7,283
Daviess	13,272	16,205	20,518	44,286	44,125	....	161
Hancock	7,050	8,220	17,837	37,032	49,854	12,822	....
Henderson	135,775	169,365	158,471	178,871	151,103	....	27,768
Hopkins	1,371,826	1,362,299	1,555,084	1,743,721	1,691,675	....	52,046
McLean	20,454	17,716	54,568	127,869	117,616	....	10,253
Muhlenberg	399,944	532,840	700,700	798,892	934,048	135,156	....
Ohio	552,665	562,974	541,226	586,072	514,126	....	71,946
Union	268,133	277,337	315,786	349,625	368,194	18,569	....
Webster	110,565	122,116	278,042	371,560	298,715	....	72,845
Other counties and small mines	....	60,000	19,153	38,306	102,018	63,712	....
Total	3,006,097	3,161,094	3,761,606	4,379,060	4,365,064	....	[a] 13,996

[a] Net decrease.

So far as the records of early coal production in the United States are to be accepted, Kentucky was the third State to enter the list of coal producers. According to one of the early reports of the Kentucky Geological Survey (published in 1838), the first coal produced in the State was mined in 1827 on "the right side of the (Cumberland) river below the mouth of Laurel." This was evidently from either Laurel or Pulaski county, but the exact location is not definitely stated. The same report says that in 1828 five boat loads of coal from these mines arrived in Nashville, and that from 1829 to 1834 probably from 25 to 35 boat loads were sent out each year. The boat loads averaged about 1,750 bushels, or 66 tons each. From 1834 to 1837 the shipments were from 75 to 100 boat loads, or about 3,500 bushels a year. The coal was for the most part consumed in the salt works and iron furnaces convenient to the rivers, the only means of transportation.

From the best information obtainable it seems that the production of the State from 1829 to 1835 ranged from 2,000 to 6,000 tons per year. The United States Census for 1840 gives the total production for the State at 23,527 short tons. By 1860, according to the census for that year, the production amounted to 285,760 short tons. Operations were necessarily somewhat interrupted during the civil war, but since 1870, after the State had begun to recover from the effects of the war, the production increased rapidly, as shown in the following table:

Annual coal production of Kentucky, 1829–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1829	2,000	1867	175,000
1830	2,000	1868	160,000
1831	2,100	1869	160,000
1832	2,500	1870 [a]	150,582
1833	2,750	1871	250,000
1834	5,000	1872	380,800
1835	6,000	1873	400,000
1836	8,000	1874	360,000
1837	10,000	1875	500,000
1838	11,500	1876	650,000
1839	16,000	1877	850,000
1840 [a]	23,527	1878	900,000
1841	35,000	1879	1,000,000
1842	50,000	1880 [a]	946,288
1843	60,000	1881	1,232,000
1844	75,000	1882	1,300,000
1845	100,000	1883	1,650,000
1846	115,000	1884	1,550,000
1847	120,000	1885	1,600,000
1848	125,000	1886	1,550,000
1849	140,000	1887	1,933,185
1850	150,000	1888	2,570,000
1851	160,000	1889	2,399,755
1852	175,000	1890	2,701,496
1853	180,000	1891	2,916,069
1854	190,000	1892	3,025,313
1855	200,000	1893	3,007,179
1856	215,000	1894	3,111,192
1857	240,000	1895	3,357,770
1858	250,000	1896	3,333,478
1859	275,000	1897	3,602,097
1860 [a]	285,760	1898	3,887,908
1861	280,000	1899	4,607,255
1862	275,000	1900	5,328,964
1863	250,000	1901	5,469,986
1864	250,000	1902	6,766,984
1865	200,000	1903	7,538,032
1866	180,000	1904	7,566,482

[a] United States census, fiscal year.

MARYLAND.

Total production in 1904, 4,813,622 short tons; spot value, $5,729,085.

The principal coal fields of Maryland, while belonging to the Appalachian field proper, are a part of an outlying basin which extends from Somerset County, Pa., through Allegany County, Md., into and including the Piedmont and Elk Garden regions of West Virginia. This area is separated from the main Appalachian system by a narrow, barren strip, but the coal itself, which is known as the "Big Vein" of Maryland, is correlated with the famous Pittsburg bed. A portion of the main bed of the Appalachian area crosses the northwestern part of Garrett County, but only a small production is obtained from this area in the State of Maryland.

The main coal basin of Allegany County, as described in the report of the Maryland Geological Survey, lies in a high, hilly, gently synclinal valley between the Allegheny Mountains on the east and the Savage Mountain on the west. Its length in Maryland is approximately 20 miles, and its average breadth about 5 miles. For more than half a century the coal fields of Maryland have been the source of some of the finest steam coal and of practically all of the high-grade blacksmith coal in the United States.

According to the report of the Maryland Geological Survey, coal was discovered by a Mr. Riser, near the present site of Frostburg, in 1804, just one hundred years before the date covered by this report. The first shipment recorded by the Cumberland Coal Trade was made in 1842, over the Baltimore and Ohio Railroad, but as early as 1830 some coal had been loaded on barges at Cumberland and floated down the Potomac River to Washington. This method, however, was too destructive of life and was the cause of so much loss in coal that it was soon abandoned, and it was not until 1842 that the industry really began to assume importance. The first shipments over the Chesapeake and Ohio Canal from Cumberland were made in 1850.

Coal production in Maryland has not varied materially during the last eight years, and it is probable that the maximum output has been reached. The areas are so limited that it appears good policy rather to operate the mines on a conservative and regular basis than to take advantage of temporary demands and push production to meet them. Since 1897 the coal production of the State has averaged about 4,750,000 short tons, the smallest during that period being made in 1900, when labor troubles reduced the output to 4,024,688 short tons, while the maximum of 5,271,609 tons was reached under the abnormal conditions brought about in 1902 by the celebrated strike in the anthracite regions of Pennsylvania.

The production in 1904, which was unaffected by strikes nor influenced by unusual conditions, amounted to 4,813,622 short tons, which, compared with 1903, when the output was 4,846,165 short tons, shows a decrease of 32,543 tons. The extraordinarily high prices which prevailed in 1903 were not so much in evidence in 1904, although the average obtained for Maryland coal during the year was considerably above those prevailing previous to 1903. The total value at the mines for the coal produced in 1904 was $5,729,085 against $7,189,784 in 1903, showing a falling off of $1,460,699, or a little over 20 per cent. The receipts to the operators in 1904 were, however, nearly $150,000 more than they were in 1902, two years before, when the production was over 450,000 tons larger.

The total number of men employed in the coal mines of Maryland in 1904 was 5,671, who made an average of 226 working days, against 5,859 men for 219 days in 1903. The average production per man for 1904 was 848.8 short tons, against 827.1 tons in 1903 and 904.6 tons in 1902. The average daily tonnage was 3.76 in 1904, 3.78 in 1903, and 3.74 in 1902. Most of the mines in Maryland were worked on a 10-hour day basis. There were 43 mines which gave employment to 4,531 men that worked 10 hours; 6 mines, with 974 men, reported 9 hours, and 2 mines, with 72 men, reported 8 hours.

There were 38 mining machines in use during 1904, and 484,373 short tons, or 10 per cent of the total product, were machine mined, as compared with 36 machines and 401,144 tons in 1903.

The statistics of production since 1889, with the distribution of the product for consumption, are shown in the following table:

Distribution of the coal product of Maryland, 1889–1904.

Year.	Loaded at mines for shipment.	Sold to local trade and used by employees.	Used at mines for steam and heat.	Total quantity.	Total value.	Average price per ton.	Average number of days active.	Average number of employees.
	Short tons.	*Short tons.*	*Short tons.*	*Short tons.*				
1889	2,885,336	44,217	10,162	2,939,715	$2,517,474	$0.86	....	3,702
1890	3,296,393	52,621	8,799	3,357,813	2,899,572	.86	244	3,842
1891	3,771,584	36,959	11,696	3,820,239	3,082,515	.80	244	3,891
1892	3,385,384	30,955	3,623	3,419,962	3,063,580	.89	225	3,886
1893	3,676,137	26,833	13,071	3,716,041	3,267,317	.88	240	3,935
1894	3,435,600	51,750	14,078	3,501,428	2,687,270	.77	215	3,974
1895	3,840,991	59,950	14,644	3,915,585	3,160,592	.81	248	3,912
1896	4,068,558	53,046	22,332	4,143,936	3,299,928	.80	204	4,039
1897	4,391,703	27,762	22,663	4,442,128	3,363,996	.76	262	4,719
1898	4,618,990	36,941	18,953	4,674,884	3,532,257	.76	253	4,818
1899	4,716,581	68,750	22,065	4,807,396	3,667,056	.76	275	4,624
1900	3,949,539	51,565	23,584	4,024,688	3,927,381	.98	203	5,319
1901	5,043,991	41,282	27,854	5,113,127	5,046,491	.99	262	5,333
1902	5,187,175	48,631	35,803	5,271,609	5,579,869	1.06	242	5,827
1903	4,752,716	53,022	40,427	4,846,165	7,189,784	1.48	219	5,859
1904	4,721,714	49,814	42,094	4,813,622	5,729,085	1.19	226	5,671

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 table following, 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

Maryland and West Virginia from 1842 to 1904, inclusive.

[Long tons.]

Frostburg region. Georges Creek and Cumberland R. R. By Chesapeake and Ohio Canal.	Frostburg region. Georges Creek and Cumberland R. R. By Pennsylvania R. R.	Frostburg region. Georges Creek and Cumberland R. R. Local and Baltimore and Ohio R. R.	Frostburg region. Georges Creek and Cumberland R. R. Total.	Piedmont region. Georges Creek R. R.	Piedmont region. Hampshire R. R. by Baltimore and Ohio R. R.	Total. Baltimore and Ohio R. R. and local.	Total. Chesapeake and Ohio Canal.	Total. Pennsylvania R. R.	Aggregate.
......	......	......	......	......	......	1,708	......	......	1,708
......	......	......	......	......	......	10,082	......	......	10,082
......	......	......	......	......	......	14,890	......	......	14,890
......	......	......	......	......	......	24,653	......	......	24,653
......	......	......	......	......	......	29,795	......	......	29,795
......	......	......	......	......	......	52,940	......	......	52,940
......	......	......	......	......	......	79,571	......	......	79,571
......	......	......	......	......	......	142,449	......	......	142,449
......	......	......	......	......	......	192,806	4,042	......	196,848
......	......	......	......	......	......	174,701	82,978	......	257,679
......	......	......	......	......	......	268,459	65,719	......	334,178
......	......	......	......	73,725	......	376,219	157,760	......	533,979
......	......	......	......	181,303	......	503,836	155,845	......	659,681
......	......	......	......	227,245	65,570	478,486	183,786	......	662,272
......	......	......	......	269,210	42,765	502,330	204,120	......	706,450
......	......	......	......	252,368	51,628	465,912	116,574	......	582,486
......	......	......	......	218,318	63,060	395,405	254,251	......	649,656
......	......	......	......	257,740	47,934	426,512	297,842	......	724,354
......	......	......	......	289,298	52,564	493,031	295,878	......	788,909
......	......	......	......	85,554	36,660	172,075	97,599	......	269,674
......	......	......	......	69,482	36,627	218,950	98,684	......	317,634
......	......	......	......	266,430	36,240	531,553	216,792	......	748,345
......	......	......	......	......	44,552	399,354	258,642	......	657,996
......	......	......	......	......	71,345	560,293	343,202	......	903,495
......	......	......	......	......	90,964	736,153	343,178	......	1,079,331
......	......	......	......	......	72,532	735,669	458,153	......	1,193,822
......	......	......	......	......	88,658	848,118	482,325	......	1,330,443
......	......	......	......	......	83,724	1,230,518	652,151	......	1,882,669
				2,190,673					

Total shipments from the Cumberland coal fields in

[Long tons.]

Year.	Frostburg region. Cumberland and Pennsylvania R. R. By Baltimore and Ohio R. R.	By Chesapeake and Ohio Canal.	By Pennsylvania R. R.	Total.	Cumberland Coal and Iron Company's R. R. (*Eckhart Branch R. R.*) By Baltimore and Ohio R. R.	By Chesapeake and Ohio Canal.	Total.
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	1,400,108	63,181	111,350	174,531
1878	823,801	486,038	145,864	1,455,703	99,455	123,166	222,621
1879	933,240	397,009	154,264	1,484,513	141,907	104,238	246,145
1880	1,055,491	471,800	213,446	1,740,737	197,525	131,325	328,850
1881	1,113,263	270,156	153,501	1,536,920	271,570	151,526	423,096
1882	576,701	115,344	91,574	783,619	199,183	76,140	275,323
1883	851,985	302,678	217,065	1,371,728	197,235	141,390	338,625
1884	1,193,780	150,471	199,138	1,543,389	289,884	124,713	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)
1904	2,792,462	205,964	234,502	3,232,928	(a)	(a)	(a)
Total	56,294,097	12,613,745	6,297,631	75,205,473	8,609,691	4,219,351	12,929,042

a Merged in Cumberland and Pennsylvania figures.

Maryland and West Virginia from 1842 to 1904, inclusive—Continued.

[Long tons.]

Frostburg region.				Piedmont region.		Total.			
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.	Aggregate.
				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	......	[b]4,672,341	222,571	1,137,264	6,032,176
......	552,993	122,180	675,173	1,997,287	......	[b]4,690,490	205,964	1,008,934	5,905,388
585,001	13,547,393	4,360,816	18,493,210	25,784,114	1,475,969	94,117,125	18,713,247	26,432,289	139,262,661

[b] Includes 201,453 tons used on line of Cumberland and Pennsylvania Railroad and its branches, and at Cumberland and Piedmont; also 383,370 tons used by the Baltimore and Ohio Railroad Company in locomotives, rolling mills, etc.

MICHIGAN.

Total production in 1904, 1,342,840 short tons; spot value, $2,424,935.

The coal fields of Michigan are confined entirely to the lower peninsula. An area of approximately 7,500 square miles is included within the coal-bearing formations, which lie almost in the exact center of the lower peninsula. This is the only known coal field within the drainage area of the Great Lakes. The developments have been principally in the eastern portion of the field and in a line running from Bay City, on the north, to Jackson, at the southern extremity of the field. The more important mining operations have been carried on in Bay and Saginaw counties, although some coal also has been mined in Shiawassee County, near Corunna, and in Eaton, Clinton, and Jackson counties.

The coals of Michigan are, as a usual thing, of a lower grade than those coming from Ohio and Pennsylvania, with which they have to compete, but the rapid development and increase of population in the cities along Lake Michigan and Lake Huron, and the Detroit and St. Clair rivers have created local markets for these coals, and the increase in production in this field during the last ten years has been unrivaled in the coal-mining industry of the United States. Up to 1896 the coal-mining industry of Michigan had been struggling along with indifferent success, reaching a total production exceeding 100,000 tons in four years only. These were 1880, 1881, 1882, and 1895. From 1897 to 1900 it increased rapidly, reaching a total of nearly 850,000 tons in 1900, and has averaged over 1,200,000 tons during the four years from 1901 to 1904, inclusive.

Coal mining in Michigan is said to have begun in the Jackson field as early as 1835. Other mines were opened at Grand Ledge, in Clinton County, as early as 1838, but while it is known that some coal was produced here in these early years, the first record of any production is that contained in the United States census report for 1860, in which year Michigan is credited with a production of 2,320 tons.

Prof. Alfred C. Lane, in the Twenty-second Annual Report of the United States Geological Survey, makes an arbitrary subdivision of the coal areas of Michigan into five local districts or fields. These, in their historical order, or according to the dates of their development, are the Jackson field, in which coal production dates back to 1835, and which had been opened in and around the site of Jackson, in Jackson County; the region around Grand Ledge, in Clinton and Eaton counties, which has been designated as the Cedar Grand field, and is about 20 miles west of the capital city of Lansing; the Owosso district, which is the one in Shiawassee County, where mines have been opened in the vicinity of Owosso and the town of Corunna. The last ones to be opened were the now more important districts of Saginaw, which includes the mines in the vicinity of Saginaw and St. Charles, in Saginaw County, and the Bay field, which includes the mines in Bay County, on the shores of Saginaw Bay, and in the vicinity of Bay City.

The coal basin lies for the most part in a low, flat country, surrounded by a rim of higher land which rises from 1,000 to 1,500 feet above the sea level, or from 500 to 1,000 feet above the lake.

According to Professor Lane, there are are 7 horizons where the coal occurs in workable thickness, although it was formerly supposed that there was only one workable bed in the State. Owing to the varying character of the formation and the manner in which the coal beds run together and separate, no hard-and-fast classification is made, but the following, which has been adopted by Professor Lane, is generally accepted as designating fairly the different beds, namely, Upper Rider, Upper Verne, Lower Verne, Middle Rider, Saginaw, Lower Rider, and Lower Coal. For more detailed descriptions of these beds the reader is referred to the Twenty-second Annual Report of the United States Geological Survey, Part III.

All of the coals produced in Michigan are of the dry, noncoking bituminous varieties. Such coke as is manufactured in the State is from coal brought in from Ohio or Pennsylvania.

The returns for 1904 show that Michigan's production amounted to 1,342,840 short tons, valued at $2,424,935, as compared with 1,367,619 short tons, valued at $2,707,527 in 1903, indicating a decrease for 1904 of 24,779 tons in quantity and of $282,592 in value. As in most of the States east of the Mississippi River which were directly or indirectly affected by the shortage of fuel in 1903, brought about by the strikes of 1902, the decreased production in Michigan last year, and particularly the loss in value, were natural reactions from the unusual conditions that preceded. There were employed in the coal mines of Michigan during 1904, 3,549 men who worked an average of 183 days against 2,768 men for an average of 222 days in 1903. The average production for each man employed in 1904 was 378.4 tons, as compared with 494.1 tons in 1903 and 411.6 tons in 1902. The average daily production per man in 1904 was 2.07 tons against 2.23 tons in 1903 and 2.4 tons in 1902. All of the coal mines in Michigan were operated on an eight-hour basis during 1904, although one mine employing 351 and one employing 8 men reported 6 hours worked each day, and 5 mines employing a total of 34 men reported 7 hours. Twenty mines which gave employment to 2,627 men worked 8 hours per day.

There was a decided increase in the use of and production by mining machines in Michigan during 1904, and this, taken in connection with the decreased output and the noticeable falling off in individual efficiency, presents an anomalous result for which no explanation is hazarded. The number of machines reported in use increased from

46 in 1903 to 85 in 1904, while the machine-mined product increased from 180,943 short tons to 310,007 short tons.

Strikes occurred in only 3 mines during the year, and these were all settled in from 3 to 5 days, so that no real interference with production resulted therefrom. The statistics of production, by counties, in 1903 and 1904, with the distribution of the product for consumption are shown in the following tables:

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 quanity.	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

Coal production of Michigan in 1904, 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	385,445	14,187	11,002	410,634	$681,048	$1.66	147	1,217
Eaton and Jackson		24,302	1,615	25,917	48,166	1.86	206	85
Saginaw	884,969	19,520	1,800	906,289	1,695,721	1.87	202	2,247
Total	1,270,414	58,009	14,417	1,342,840	2,424,935	1.81	183	3,549

The production, by counties, during the last five years, with the increases and decreases in 1904 as compared with 1903, has been as follows:

Coal production of Michigan, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase 1904.	Decrease 1904.
Bay	190,814	253,821	248,645	325,021	410,634	85,613	
Eaton	4,530	4,803	8,080	7,393	9,057	1,664	
Genesee	300						
Huron	5,953	7,850	5,400				
Jackson	23,317	20,288	23,889	23,307	16,860		6,447
Saginaw	601,112	938,042	670,304	1,011,898	906,289		105,609
Shiawassee	23,449	16,437	8,400				
Total	849,475	1,241,241	964,718	1,367,619	1,342,840		[a]24,779

[a] Net decrease.

According to the United States census for 1860 the coal production of Michigan amounted in that year to 2,320 short tons. This is the first record of coal production we have for the State. The industry did not develop to much importance, however, until the last few years, when the growth of industrial cities along the Great Lakes and the higher prices of Ohio and Pennsylvania coals have created a demand for Michigan coals, which has resulted in the building up of an important coal-mining industry in the State. This is shown in the following table:

Coal production of Michigan, 1860–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1860 [a]	2,320	1883	71,296
1861	3,000	1884	36,712
1862	5,000	1885	45,178
1863	8,000	1886	60,434
1864	12,000	1887	71,461
1865	15,000	1888	81,407
1866	20,000	1889	67,431
1867	25,000	1890	74,977
1868	28,000	1891	80,307
1869	29,980	1892	77,990
1870 [a]	28,150	1893	45,979
1871	32,000	1894	70,022
1872	33,600	1895	112,322
1873	56,000	1896	92,882
1874	58,000	1897	223,592
1875	62,500	1898	315,722
1876	66,000	1899	624,708
1877	69,197	1900	849,475
1878	85,322	1901	1,241,241
1879	82,015	1902	964,718
1880 [a]	100,800	1903	1,367,619
1881	112,000	1904	1,342,840
1882	135,339		

[a] United States census, fiscal year.

MISSOURI.

Total production in 1904, 4,168,308 short tons; spot value, $6,837,886.

The coal measures of Missouri occupy the northwestern half of the State and underlie approximately 23,000 square miles, of which 14,000 are considered to be probably productive territory. The beds belong to the Pennsylvanian series of the Carboniferous, and, as in Iowa, include two well-marked divisions, a lower and an upper. The lower or productive portion occupies a belt along the eastern edge of the field, and mining is confined entirely to this area. The formation consists largely of shales and sandstones with a few thin limestones in the upper part. The coal beds are from 4 to 6 feet thick in most situations, but are patchy in distribution. The coal is of a dry non-coking bituminous grade. Near the edge of the field are several outliers of very thick coal occupying erosion depressions in the underlying limestones. These have small economic importance, but have created a great deal of interest and have led to the loss of considerable money in exploration. The total thickness of the coal measures is estimated at 2,000 feet and increases from the outcrop to the northwest, in which direction the beds have a gentle dip. The productive areas of the State include: (1) The northern, occupying Putnam and adjacent counties, and in which the extension of the Centerville coal of Iowa is mined. From this field approximately 3 per cent of the State's output comes. (2) The northeastern, including Macon, Randolph, and adjacent counties, and in which coal is mined from the lower beds of the coal measures. Approximately 44 per cent of the State's output is derived from this district. (3) In the central district the more important mines are in Lafayette and Ray counties, and the district as a whole yields about 22 per cent of the output of the State. (4) The southwestern district in which the more important mines are in Vernon County. These work in part an extension of the Cherokee coal of Kansas, and in part they take coal from other beds also in the lower portion of the coal measures. The output of this district is about 5 per cent of that of the State.

The total amount of coal produced in Missouri in 1904 was 4,168,308 short tons, valued at $6,837,886, which, compared with the production of 4,238,586 short tons, valued at $6,834,297, in 1903, exhibits a decrease of 70,278 short tons in quantity and an increase of $3,589 in value. Missouri is one of the few States in which the average price in 1904 showed an advance over 1903 and in which there was an increase in the total value of the coal produced.

There were employed in the coal mines of Missouri during 1904 a total of 10,137 men, who worked for an average of 206 days, as compared with 9,544 men, working an average of 215 days in 1903, and 9,742 men, working an average of 202 days in 1902. By dividing the total production by the total number of men employed, it is found that in 1904 the average amount of coal produced by each employee was 411.2 short tons, as compared with 444.1 tons in 1903 and 399.5 in 1902. The average tonnage per man per day was 2 in 1904, 2.07 in 1903, and 1.98 in 1902. This decrease in production, as well as the decrease in the average tonnage per man, was in spite of the fact that there was a larger production by the use of machines in 1904 than in 1903. The statistics for 1904 show that there were 31 machines in use and that 376,505 short tons was the total machine-mined product. In 1903 33 machines were used in the production of 311,602 short tons.

Most of the mines of Missouri were operated on an 8-hour basis both in 1903 and 1904, and the falling off in the daily or yearly production per man can not be ascribed to any difference in the working time. In 1903 9,119 men out of a total of 9,544 were employed in mines that worked on an 8-hour basis and in 1904 9,686 out of a total of 10,137 men worked on an 8-hour basis.

The statistics of the production of coal in Missouri in 1903 and 1904 by counties, with the distribution of the product for consumption, are shown in the following tables:

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
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	206,337	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.

Coal production of Missouri in 1904, 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	600,839	5,240	9,528	615,607	$951,163	$1.55	215	1,188
Audrain	28,307	14,040	1,832	44,179	80,684	1.83	259	180
Barton	218,656	8,554	3,665	230,875	313,738	1.36	205	450
Bates	129,428	5,238	4,360	139,026	192,721	1.39	181	331
Boone	17,375	19,315	1,230	37,920	68,453	1.81	214	95
Callaway	1,200	10,858	....	12,058	22,796	1.89	236	66
Henry	107,963	25,098	1,590	134,651	259,432	1.93	190	317
Lafayette	628,002	39,238	15,179	682,419	1,219,468	1.79	215	1,899
Linn	87,561	21,903	1,631	111,095	241,853	2.18	232	303
Macon	888,886	7,977	17,440	914,303	1,393,102	1.52	212	1,982
Putnam	66,542	3,599	1,125	71,266	130,864	1.84	146	290
Ralls	16,364	200	8	16,572	29,001	1.75	241	51
Randolph	558,270	17,493	9,372	585,135	897,305	1.53	203	1,429
Ray	209,565	25,368	9,774	244,707	479,826	1.96	187	862
Vernon	167,606	2,090	8,310	178,006	267,010	1.50	216	179
Other counties[a]	76,836	31,637	5,775	114,248	220,711	1.93	180	515
Small mines	....	36,241	....	36,241	69,759	......	......	......
Total	3,803,400	274,089	90,819	4,168,308	6,837,886	1.64	206	10,137

[a] Caldwell, Chariton, Clay, Dade, Grundy, Howard, Jackson, Johnson, Livingston, Moniteau, Monroe, Montgomery, Morgan, Pettis, St. Clair, and Schuyler.

In the following table is shown the production of Missouri during the last five years, by counties, with the increases and decreases in 1904 as compared with 1903:

Coal production in Missouri, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase 1904.	Decrease 1904.
Adair	244,314	358,011	331,159	526,975	615,607	88,632	....
Audrain	44,074	35,916	26,208	26,835	44,179	17,344	....
Barton	166,592	144,354	200,346	193,816	230,875	37,059	....
Bates	270,712	281,020	354,707	149,963	139,026	....	10,937
Boone	18,619	22,629	27,006	19,752	37,920	18,168	....
Caldwell	34,100	20,430	16,000	11,485	15,366	3,881	....
Callaway	16,435	28,008	26,422	25,837	12,058	....	13,779
Cole	....	....	....	....	....	....	....
Grundy	39,239	42,361	34,936	25,565	15,597	....	9,968
Henry	81,010	82,586	98,831	59,710	134,651	74,941	....
Jackson	16,700	20,000	21,000	8,500	4,050	....	4,450
Johnson	4,939	11,255	5,540	1,458	1,572	114	....
Lafayette	457,858	438,922	543,801	639,480	682,419	42,939	....
Linn	71,311	85,256	81,108	66,319	111,095	44,776	....
Livingston	1,200	900	2,138	4,095	2,959	....	1,136
Macon	836,248	1,040,976	1,064,726	1,180,653	914,303	....	266,350
Montgomery and Morgan	2,146	3,474	[a]4,101	7,583	8,146	563	....
Putnam	111,626	133,397	127,983	112,740	71,266	....	41,474
Ralls	20,145	23,688	19,372	17,185	16,572	....	613
Randolph	442,456	403,403	424,167	604,240	585,135	....	19,105
Ray	216,617	267,432	235,066	296,922	244,707	....	52,215
Vernon	322,827	238,070	218,339	181,358	178,006	....	3,352
Other counties and small mines	120,935	120,000	27,198	78,115	102,799	24,684	....
Total	3,540,103	3,802,088	3,890,154	4,238,586	4,168,308	....	[b]70,278

[a] Montgomery County only. [b] Net decrease.

As far as any records are obtainable, coal mining began in Missouri in 1840, the United States census for that year recording a production of 9,972 tons. Since 1840 the production has been as shown in the following table, the output of the years 1841 to 1869, inclusive, being estimated from the best information available:

Coal production of Missouri, 1840–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1840 [a]	9,972	1873	784,000
1841	12,000	1874	789,680
1842	15,000	1875	840,000
1843	25,000	1876	1,008,000
1844	35,000	1877	1,008,000
1845	50,000	1878	1,008,000
1846	68,000	1879	1,008,000
1847	80,000	1880 [a]	844,304
1848	85,000	1881	1,960,000
1849	90,000	1882	2,240,000
1850	100,000	1883	2,520,000
1851	125,000	1884	2,800,000
1852	140,000	1885	3,080,000
1853	160,000	1886	1,800,000
1854	175,000	1887	3,209,916
1855	185,000	1888	3,909,967
1856	200,000	1889	2,557,823
1857	220,000	1890	2,735,221
1858	240,000	1891	2,674,606
1859	260,000	1892	2,773,949
1860 [b]	280,000	1893	2,897,442
1861	300,000	1894	2,245,039
1862	320,000	1895	2,372,393
1863	360,000	1896	2,331,542
1864	375,000	1897	2,665,626
1865	420,000	1898	2,688,321
1866	450,000	1899	3,025,814
1867	500,000	1900	3,540,103
1868	541,000	1901	3,802,088
1869	550,000	1902	3,890,154
1870 [a]	621,930	1903	4,238,586
1871	725,000	1904	4,168,308
1872	784,000		

[a] United States census, fiscal year.
[b] Census figures for 1860 are 3,880 short tons, but this is evidently an error.

MONTANA.

Total production in 1904, 1,358,919 short tons; spot value, $2,194,548.

Although most of the coal of Montana is of cretaceous age, coal-bearing formations are found in all rocks, from the Jurassic to the Tertiary. The coal found in the Jurassic, however, is too thin to be profitably worked. The coals of Montana vary in character, from lignite to bituminous, some of the latter being fair coking coals. The total area of Montana underlain by coal is estimated at 32,000 square miles. The producing areas are in somewhat widely separated fields, among which may be mentioned the Bull Mountain field, northeast of Billings, where a considerable amount of prospecting and development work has been done. The coal of this field is lignitic in character. In the Clarks Fork field, in the southwestern portion of Yellowstone and northeastern part of Sweetgrass counties, and extending southwestward through Carbon County, the coal is lignitic and not at present worked to any large extent. The Rocky Fork field, in Carbon County, contains five different beds of coal, varying in thickness from 4 feet to 7 feet 9 inches. All of this coal is between lignite and bituminous, and said to make an excellent steam and domestic coal. The Yellowstone field and the Trail Creek field are located in Park and Gallatin counties, and cover the operations in and around Bozeman and Livingston. The Cinnabar field is a small area lying just north of the Yellowstone National Park, and west of this are the West Gallatin and Ruby Valley fields, which have not yet been developed to any extent. Other areas are the Toston, Smith River, and Belt, of Great Falls fields, the last mentioned being the most important. Some of the largest mines in the State are those at Cottonwood, in Cascade County.

Judging from the activity in the coal-mining industry of Montana, there has been little or no change in the industrial conditions of the State during the last ten years. Coal production has remained practically stationary during that time, ranging from a minimum of 1,358,919 short tons in 1904 to 1,661,775 in 1900, and averaging 1,513,818 short tons for the entire period. The greater part of the coal production in Montana is used by railroad locomotives, and as there has been no railroad building to speak of in the State for the last ten years the stationary condition of the coal-mining industry may be accounted for. The production in 1904 was the smallest tonnage recorded since 1894. Compared with 1903, when the output was 1,488,810 short tons, the production in 1904 exhibits a decrease of 129,891 short tons, or 8.7 per cent. The value of the product decreased from $2,440,846 in 1903 to $2,194,548 in 1904, a loss of $246,298, or a little over 10 per cent.

During 1904 the coal mines of Montana gave employment to a force of 2,505 men that averaged 243 working days each, against 2,155 men for 254 days in 1903. The average production per man employed for the year in 1904 was 542.5 tons, against 691 in 1903, and 805 in 1902. The average daily tonnage per man was 2.23 in 1904, 2.72 in 1903, and 2.98 in 1902. The majority of the mine workers in Montana worked 9 hours a day, all of the larger mines but 2 reporting a 9-hour day. There were 19 mines, employing altogether 646 men, that reported 8 hours, 8 mines, employing 1,653 men, reported 9 hours, and 4 mines, employing 12 men, worked 10 hours. No daily working time was reported from mines employing 194 men.

The coal mines of Montana were comparatively free from labor troubles during 1904, strikes having been reported at only 2 mines. One strike lasted 40 days, while the other was settled in 8 days.

The use of mining machines has shown a steady decline since 1900. In that year there were 81 machines in use, and 1,045,115 tons, or 62.89 per cent of the total product, was machine mined. In 1903 the number of machines in use had decreased to 63 and the machine-mined tonnage to 693,504, or 46.6 per cent of the total. The returns to the Survey for 1904 showed 57 machines in use, while only 482,924 short tons, or 35.5 per cent of the total, were machine mined. This decrease in the production by the use of machines is probably responsible, at least in part, for the rather decided decrease in tonnage per man referred to in a preceding paragraph.

The statistics of production, by counties, in 1903 and 1904, with the distribution of the product for consumption, are shown in the following tables:

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
Chouteau	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.

Coal production of Montana in 1904, 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	513,809	9,807	21,360	....	544,976	$795,531	$1.46	279	688
Cascade	534,234	11,202	38,628	15,094	599,158	926,670	1.55	237	1,121
Chouteau	800	4,964	....	....	5,764	12,092	2.10	183	18
Fergus	8,118	10,409	582	....	19,109	68,520	3.59	225	57
Park	18,900	8,996	3,250	47,500	78,646	227,226	2.89	213	265
Other counties [a]	63,000	2,130	9,454	35,772	110,356	162,579	1.47	218	356
Small mines	....	910	....	....	910	1,930	......	....	....
Total	1,138,861	48,418	73,274	98,366	1,358,919	2,194,548	1.61	243	2,505

[a] Deerlodge, Gallatin, Meagher, and Sweet Grass.

The production by counties during the last five years, with the increases and decreases in 1904 as compared with 1903, is shown in the following table:

Production of coal in Montana, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase, 1904.	Decrease, 1904.
Carbon	393,877	498,560	604,954	589,997	544,976	....	45,021
Cascade	1,123,395	789,407	761,572	733,064	599,158	....	133,906
Chouteau	5,757	5,050	10,772	9,875	5,764	....	4,111
Fergus	900	500	5,200	9,734	19,109	9,375	....
Gallatin	51,671	24,583	88,000	58,696	109,556	50,860	....
Park	86,025	77,981	89,640	86,044	78,646	....	7,398
Other counties and small mines	150	....	685	[a] 1,400	1,710	310	....
Total	1,661,775	1,396,081	1,560,823	1,488,810	1,358,919	....	[b] 129,891

[a] Includes production of small mines. [b] Net decrease.

The first record of coal production in Montana was twenty-five years ago, in 1880, when the output amounted to only 224 tons. Up to 1888 the development had been rather slow, amounting to 41,467 tons in that year. In 1889 it jumped to 363,301 tons and increased rapidly until 1895, when it reached a total of something over 1,500,000 tons, and has averaged approximately this quantity each year since then.

Coal production of Montana, 1880–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1880	224	1893	892,309
1881	5,000	1894	927,395
1882	10,000	1895	1,504,193
1883	19,795	1896	1,543,445
1884	80,376	1897	1,647,882
1885	86,440	1898	1,479,803
1886	49,846	1899	1,496,451
1887	10,202	1900	1,661,775
1888	41,467	1901	1,396,081
1889	363,301	1902	1,560,823
1890	517,477	1903	1,488,810
1891	541,861	1904	1,358,919
1892	564,648		

NEW MEXICO.

Total production in 1904, 1,452,325 short tons; spot value, $1,904,499.

Like the other coals of the Rocky Mountain region, the coals of New Mexico are of Cretaceous age and vary from lignite to anthracite. The anthracite areas are, however, those in which the coal has been locally metamorphosed by volcanic intrusion, and the producing areas are small. The production of anthracite from the Territory does not amount to 50,000 tons a year. As in Colorado, the known producing areas of New Mexico occur in somewhat widely separated localities. The principal fields are the Raton field, in Colfax County, which is the southern end of the same field in Colorado; the La Plata field, which also extends south of the Colorado line into Rio Arriba County; the Mount Taylor field, which is really the southern extension of the La Plata field, in McKinley County, and the Gallup field, in the western part of the same county. The Los Cerillos and Tejon areas, in Santa Fe County, and the Whiteoaks field, in Lincoln County, make up the principal producing areas. A considerable amount of development work is now being carried on in the Gallup field, and this is expected to prove of decided importance in the future. Some of the coals of New Mexico are true coking bituminous coals, and a considerable quantity of coke is made in the Territory each year.

The production of coal in New Mexico in 1904 amounted to 1,452,325 short tons, valued at $1,904,499, against 1,541,781 short tons, valued at $2,105,785 in 1903, showing a decrease in output of 89,456 short tons, and in value of $201,286. This decrease may be attributed rather to the abnormally large production in 1903 than to any actual falling off in business during 1904. Idleness due to labor troubles in the coal mines of Colorado in 1903 stimulated a demand for New Mexico coal in that year, and the production increased nearly 500,000 tons and reached a total exceeding 1,500,000 tons for the year.

Nothwithstanding the decreased production, the returns to the Survey show that the number of men employed increased from 1,789 in 1903 to 1,849 in 1904. The average number of working days decreased, however, from 260 to 228. This resulted in a decrease in the average production per man from 862 tons in 1903 to 785.5 tons in 1904, while the average daily tonnage per man increased from 3.31 to 3.45. The productive capacity per man has, in fact, increased each year since 1901, when the average daily production for each employee was 1.96 tons. Most of the mines of the Territory are worked on a 10-hour-day basis. There were 15 mines, employing 1,680 men, in 1904 that reported 10 hours as the length of the working day; 1 mine with 31 men reported 9 hours, 6 mines employing 78 men worked 8 hours, and 1 mine having 60 men reported 7 hours.

Strikes occurred in 3 coal mines in New Mexico during 1904. In one case 400 men were idle for 160 days, in another 150 men were out for 60 days, and in the third 6 men were out for 15 days. It is possible that but for the time lost by the first two, and which amounted altogether to 73,090 working days, the production for the Territory in 1904 would have equaled that of 1903, when only 710 days were lost by strikes.

There are only 2 mines in the Territory using mining machines, and the number of machines in use was the same in 1904 as in 1903. The machine-mined production decreased slightly from 105,000 tons to 100,000 tons.

In the following tables is shown the production by counties in 1903 and 1904, with the distribution of the product for consumption:

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.

Coal production of New Mexico in 1904, 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	657,359	12,828	15,457	103,311	788,955	$931,003	$1.18	223	745
McKinley	429,205	2,312	10,348	....	441,865	581,719	1.32	226	695
Rio Arriba	34,825	5,500	500	....	40,825	63,062	1.54	247	65
Santa Fe	49,070	363	10,657	....	60,090	114,024	1.90	283	120
Other counties[a]	111,742	4,044	4,662	....	120,448	214,519	1.78	215	224
Small mines	....	142	....	....	142	172	....	....	....
Total	1,282,201	25,189	41,624	103,311	1,452,325	1,904,499	1.31	228	1,849

[a] Lincoln, Sandoval, San Juan, and Socorro.

The production by counties during the last five years and the increases and decreases in 1904 as compared with 1903 are shown in the following table:

Coal production of New Mexico, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase, 1904.	Decrease, 1904.
McKinley	450,646	516,533	432,108	569,362	441,865	....	127,497
Colfax	388,480	249,296	346,373	723,786	788,955	65,169	....
Lincoln	150,442	156,621	99,000	97,229	70,964	....	26,265
Rio Arriba	45,800	38,942	47,600	35,500	40,825	5,325	....
Santa Fe	252,731	106,454	90,895	75,535	60,090	....	15,445
Other counties	11,200	18,700	32,787	40,369	49,626	9,257	....
Total	1,299,299	1,086,546	1,048,763	1,541,781	1,452,325	....	[a]89,456

[a] Net decrease.

The first record of coal production in New Mexico is that contained in the first volume, Mineral Resources of the United States, published in 1882. In that year the production amounted to 157,092 tons, a little more than one-tenth of what it is at the present time.

Coal production of New Mexico, 1882–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1882	157,092	1894	597,196
1883	211,347	1895	720,654
1884	220,557	1896	622,626
1885	306,202	1897	716,981
1886	271,285	1898	992,288
1887	508,034	1899	1,050,714
1888	626,665	1900	1,299,299
1889	486,943	1901	1,086,546
1890	375,777	1902	1,048,763
1891	462,328	1903	1,541,781
1892	661,330	1904	1,452,325
1893	665,094		

NORTH CAROLINA.

Total production in 1904, 7,000 short tons; spot value, $10,500.

There are two areas in North Carolina in which coal occurs. Both of these are found in the Triassic formation and are of the same age as the Richmond coal basin, in Virginia. The two areas are known as the Deep and Dan River fields, being named from the two rivers which drain them. The only productive beds at present are those in the Deep River district, in Chatham and Moore counties. For several years practically all of the production has been from one mine, the Cumnock, near Egypt, in Chatham County.

The United States census of 1840 stated that a production of 3 tons was obtained from North Carolina in that year. There is no evidence of any other production prior to the civil war, when the necessities of the Confederate government were partly relieved by coal obtained from this region. After the war the production fell off for several years, and from 1874 to 1879 none was reported from this area. The Cumnock or Egypt mines were reopened in 1889, and have been producing each year since that time.

The conditions in the Cumnock mines are not favorable for machine mining and all of the coal is undercut by hand.

The statistics of production since 1891, with the distribution of the product for consumption, are shown in the following table:

Distribution of the coal product of North Carolina, 1891–1904.

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	49
1904	4,600	300	2,100	7,000	10,500	1.50	240	25

As previously stated, the census of 1840 reported a production of 3 tons of coal in North Carolina, and the mines were most extensively worked during the civil war. From 1874 to 1879, inclusive, the mines were idle. The production each year, so far as known, has been as follows:

Coal production of North Carolina, 1840–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1840	3	1886	400
1862	30,000	1887	300
1863	30,000	1888	250
1864	25,000	1889	222
1865	20,000	1890	10,262
1866	20,000	1891	20,355
1867	20,000	1892	6,679
1868	18,000	1893	17,000
1869	16,000	1894	16,900
1870	15,000	1895	24,900
1871	15,000	1896	7,813
1872	12,000	1897	21,280
1873	10,000	1898	11,495
1880	350	1899	26,896
1881	300	1900	17,734
1882	400	1901	12,000
1883	400	1902	23,000
1884	500	1903	17,309
1885	500	1904	7,000

NORTH DAKOTA.

Total production in 1904, 266,128 short tons; spot value, $378,032.

A large part of the western half of North Dakota is underlain by extensive beds of brown lignite coal. This lignite contains a large amount of moisture, as high as 40 per cent, which causes it to disintegrate upon exposure, and as a consequence it does not stand transportation to any great distance. Its principal use so far has been to supply fuel to the settlers on the treeless plains of western North Dakota, and has been used to some extent under boilers, but on account of its large percentage of moisture it does not make a satisfactory steam fuel. The total area of North Dakota underlain by lignites is estimated at 28,620 square miles.

The work of the United States Geological Survey coal-testing plant at St. Louis has shown that the lignites of North Dakota, as other lignites in the far west and in the Rocky Mountain region, can be used as a fuel in the gas producer with entire satisfaction. In fact, it has been shown that a higher grade of producer gas may be obtained from lignite than can be made from bituminous or anthracite coal or coke. In a run of thirty hours the gas from a North Dakota lignite averaged

188 B. T. U.'s per cubic foot of gas, whereas the calorific value of the gas from anthracite or of bituminous coal ranges from 135 to 155 B. T. U.'s per cubic foot. It was shown, moreover, by using lignite in the gas producer and consuming the gas in an internal combustion gas engine, as much electrical energy could be obtained from a ton of lignite as is obtainable from the best bituminous steam coals under boilers. It is known that power may be transmitted electrically to a distance of 250 miles, with a loss of less than 10 per cent, and from the facts brought out by the testing work at St. Louis, there is no reason why there should not be an extensive development in the lignite beds of North Dakota and those of the other Western States in the near future.

Some lignite has doubtless been produced in North Dakota for a number of years and used by ranchmen for fuel, but it was not until 1884 that any record of production was obtained. This was published in the volume, Mineral Resources of the United States, for that year, and showed a total production of 35,000 tons. The output did not increase materially until 1896, when it reached a total of 78,050 tons. During the last eight or nine years, stimulated by the State law, which compelled the use of North Dakota lignites in all State buildings and offices, the production increased quite rapidly, until 1903, when the maximum output of 278,645 short tons was obtained.

The production in 1904 shows a slight decrease from that of the preceding year, the output falling off from 278,645 tons to 266,128 tons, while the value decreased from $418,005 to $378,032. The average price per ton declined from $1.50 to $1.42.

Nearly one-half of the total product in 1904, or 125,097 short tons, was mined by machines, of which there were nine in use.

The statistics of production in the last two years, with the distribution of the product for consumption, is shown in the following tables:

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

Coal production of North Dakota in 1904, 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	5,700	4,863	100	10,663	$15,239	$1.43	100	35
Stark	38,919	13,000	825	52,744	61,757	1.17	230	68
Ward	41,367	37,898	2,701	81,966	148,371	1.81	162	250
Williams	7,280	1,775	130	9,185	16,274	1.77	97	44
Other counties[a]	87,390	19,749	1,031	108,170	130,991	1.21	271	150
Small mines	....	3,400	....	3,400	5,400	......	....	....
Total	180,656	80,685	4,787	266,128	378,032	1.42	191	547

[a] Burleigh, Emmons, McLean, and Mercer.

In the following table is shown the production by counties during the last five years, with the increases and decreases in 1904 as compared with 1903:

Coal production of North Dakota 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase 1904.	Decrease 1904.
Burleigh	9,210	44,054	76,258	104,835	92,970	....	11,865
McLean	3,154	1,000	3,150	3,925	13,100	9,175	....
Morton	27,428	52,850	18,317	13,500	10,663	....	2,837
Stark	29,050	18,700	35,000	46,764	52,744	5,980	....
Ward	60,641	48,681	93,786	98,081	81,966	....	16,115
Williams	....	....	....	8,935	9,185	250	....
Emmons, Mercer	400	1,316	....	....	2,100	2,100	....
Small mines	....	....	....	2,605	3,400	795	....
Total	129,883	166,601	226,511	278,645	266,128	....	[a]12,517

[a] Net decrease.

Since 1884, when the first production was reported in Mineral Resources of the United States, the output has been as follows:

Coal production of North Dakota, 1884–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1884	35,000	1895	38,997
1885	25,000	1896	78,050
1886	25,955	1897	77,246
1887	21,470	1898	83,895
1888	34,000	1899	98,809
1889	28,907	1900	129,883
1890	30,000	1901	166,601
1891	30,000	1902	226,511
1892	40,725	1903	278,645
1893	49,630	1904	266,128
1894	42,015		

OHIO.

The total production in 1904 was 24,434,812 short tons; spot value, $26,588,476.

The areas in Ohio now or formerly underlain by coal are estimated at 12,000 square miles. Much of the coal, however, has been exhausted, and the workable areas at the present time are much below this figure. The coal-bearing formations contain at least 16 different coal beds within the State. Of these, 6 are important and have been developed on a large scale, while the other 10 have been developed principally by small mines, a large part of the output of which is sold for local consumption. The important productive beds are the Block (Sharon coal), or No. 1; Wellston, or No. 2; Lower Kittanning, No. 5; Middle Kittanning, No. 6; Upper Freeport, No. 7; and Pittsburg, No. 8.

Some of the coals of Ohio are celebrated for certain uses. That of the Hocking Valley region, which is contained in Perry, Athens, and Hocking counties, is a free, open-burning coal, highly regarded as a steam and domestic coal, but more popular as a furnace fuel, for which purpose it is used raw. The Hocking Valley coal belongs to the Middle Kittanning, or No. 6 bed. The No. 7, or Upper Freeport coal, which is mined in Muskingum, Gallia, Lawrence, and Guernsey counties, and in portions of Perry County, is a high-grade steam fuel and would make, except for its high contents of sulphur, an excellent coke. On account of the high sulphur, however, no coke is made from this coal in the State. The Pittsburg bed, or No. 8 of the State series, lies in Jefferson, Harrison, Belmont, Guernsey, Athens, and Meigs counties. It is the base of the Upper Coal Measures in the State, and is the most important of all the beds within these Measures.

Coal No. 1, or the block coal, is mined in the northeastern counties of the State, especially in Summit, Stark, Trumbull, and Mahoning counties, and a small quantity in Portage County. This coal is very pure and is used principally in making pig iron, for which it is used in its raw state in the blast furnaces. It was this coal which first supplanted charcoal in the blast furnaces of the State. It is dry, free-burning, and does not coke. The Massillon coal, highly prized for domestic purposes in Cleveland and other cities on the Lakes, is obtained from this bed. The Wellston bed, which lies above the block, is the most important producing bed in the southern portion of the State. The mines in Jackson County, at Jackson and Wellston, are worked on this bed.

Ohio now ranks fourth among the coal-producing States, having been supplanted in second place by Illinois in 1883 and by West Virginia for third place in 1896. Ohio's production in 1904, like that of most of the States in sympathy with the general reaction from 1903, shows a small decrease in quantity and a decided falling off in value. The output in 1904 was 24,434,812 short tons against 24,838,103 tons in 1903, a decrease of 403,291 tons, while the value decreased from $31,932,327 to $26,588,476, a loss of $5,343,851.

Although the coal output of Ohio in 1904 was less than that of 1903, the number of men employed in its production increased from 41,936 to 43,691 which was partly compensated for by a reduction in the number of working days from 194 in 1903 to 175 in 1904, and which was due principally to loss of time through strikes. During 1904 strikes occurred at 90 different mines in Ohio, through which 11,412 men were made idle for an average of 45 days each, the total time lost amounting to 514,658 working days. In 1903 the total time lost by reason of strikes in the Ohio coal mines was 65,149 working days, an average of 16 days for each of the 4,115 men affected.

Considering the production during the last two years in connection with the number of men employed and the time made by them, it is found that in 1904 the average production for each employee was 559.3 short tons, and the daily production per man 3.2 tons, while in 1903 the average yearly tonnage per man was 592 and the average daily tonnage was 3.05. In 1902 the average production per man for the year was 604, and as the average working time was 200 days, the daily production per man was 3.02 tons. The coal mines of the State have been, for the most part, worked on an 8-hour basis during the last two years. In 1904, 574 mines, employing a total of 42,845 men, reported 8 hours for a working day. Nine mines, having 296 men, reported 9 hours, and 7 mines, with 77 men, reported 10 hours. Fourteen comparatively small mines reported 6 or 7 hours.

The amount of coal undercut by machines in Ohio during 1903 and 1904 was almost the same in both years. In 1903, 14,007,326 short tons, or 56.39 per cent of the total product, was machine-mined, while in 1904 this factor amounted to 14,001,647 short tons, or 57.3 per cent of the total.

The statistics of production in 1903 and 1904, by counties, with the distribution of the product for consumption, are shown in the following tables:

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	489
Columbiana	827,218	60,557	19,550	....	907,325	1,167,664	1.29	230	1,470
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	138
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	4,293
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	3,293,805	1.21	150	4,952
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	2,630
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	183	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	41,936

[a] Morgan, Scioto, and Washington.

Coal production of Ohio in 1904, 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	3,260,722	39,486	43,407	....	3,343,615	$3,564,752	$1.07	163	5,567
Belmont	2,936,722	172,615	62,813	200	3,172,350	2,998,390	.95	186	4,483
Carroll	198,696	29,191	7,123	....	235,010	253,235	1.08	178	510
Columbiana	686,882	94,100	21,685	....	802,667	878,080	1.09	278	1,480
Coshocton	302,693	37,187	464	....	340,344	422,838	1.24	160	852
Gallia	21,762	7,880	....	....	29,642	32,329	1.09	157	114
Guernsey	2,985,180	46,138	51,549	41,835	3,124,702	2,817,986	.90	199	4,060
Harrison	238,866	22,969	2,684	....	264,519	270,910	1.02	151	480
Hocking	2,399,809	42,173	16,420	....	2,458,402	2,554,683	1.04	204	3,086
Holmes	11,903	18,506	119	....	30,528	41,079	1.35	188	93
Jackson	1,868,799	27,371	40,281	....	1,936,451	2,949,285	1.52	181	4,336
Jefferson	2,207,217	178,826	29,123	956	2,416,122	2,417,965	1.00	164	4,496
Lawrence	138,975	27,898	16,731	....	183,604	221,947	1.21	167	562
Mahoning	45,100	38,533	3,882	....	87,515	130,629	1.49	177	221
Medina	73,286	19,840	5,307	....	98,433	149,279	1.52	195	197
Meigs	133,601	50,866	929	....	185,396	201,191	1.09	106	789
Muskingum	145,348	111,950	200	....	257,498	266,708	1.04	158	493
Perry	2,341,189	69,539	42,188	....	2,452,916	2,461,057	1.00	144	4,918
Portage	92,320	5,572	3,158	....	101,050	208,200	2.06	162	346
Stark	638,341	92,319	37,453	....	768,113	1,409,679	1.87	158	2,143
Summit	64,625	19,610	5,750	....	89,985	133,054	1.48	153	346
Tuscarawas	1,347,832	188,945	14,985	303	1,552,065	1,570,664	1.01	169	2,938
Vinton	199,815	1,249	5,558	....	206,622	263,161	1.27	159	564
Wayne	77,657	907	2,805	....	81,369	135,428	1.66	144	276
Other counties[a]	179,437	15,876	1,900	....	197,213	213,524	1.08	172	341
Small mines	....	18,681	....	....	18,681	22,423	....	....	....
Total	22,596,777	1,378,227	416,514	43,294	24,434,812	26,588,476	1.09	175	43,691

[a] Morgan, Noble, Scioto, Trumbull, and Washington.

Of the 29 counties producing coal in Ohio during 1904 there were 11 in which the production was larger than in 1903, and 18 in each of which a decrease was shown. The principal increases were in Belmont and Guernsey counties, both of which attained for the first time a production exceeding 3,000,000 tons, while the largest decreases were sustained by Jackson and Perry counties. The increase or decrease in each county is shown in the following table, which exhibits also the production by counties during the last five years:

Coal production of Ohio, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase 1904.	Decrease 1904.
Athens	2,283,520	2,968,720	3,319,597	3,424,958	3,343,615	....	81,343
Belmont	1,345,284	1,506,858	1,997,956	2,725,849	3,172,350	446,501	....
Carroll	167,521	180,773	225,379	254,440	235,010	....	19,430
Columbiana	692,264	734,680	793,858	907,325	802,667	....	104,658
Coshocton	353,314	413,579	437,784	454,008	340,344	....	113,664
Gallia	15,620	14,826	21,470	48,948	29,642	....	19,306
Guernsey	1,852,327	2,287,870	2,655,610	2,776,829	3,124,702	347,873	....
Harrison	6,342	79,692	361,492	259,047	264,519	5,472	....
Hocking	2,518,605	2,768,772	2,641,141	2,506,410	2,458,402	....	48,008
Holmes	....	....	14,785	41,338	30,528	....	10,810
Jackson	2,304,892	2,175,316	2,412,509	2,411,145	1,936,451	....	474,694
Jefferson	1,110,586	1,322,305	1,812,801	2,479,211	2,416,122	....	63,089
Lawrence	95,425	107,216	183,369	228,251	183,604	....	44,647
Mahoning	46,462	109,349	127,747	123,206	87,515	....	35,691
Medina	129,913	108,684	90,718	132,823	98,433	....	34,390
Meigs	242,275	237,614	339,639	316,888	185,396	....	131,492
Morgan	24,004	27,276	86,821	93,675	83,800	....	9,875
Muskingum	184,274	137,670	225,413	281,649	257,498	....	24,151
Perry	2,364,791	2,446,872	2,743,997	2,731,282	2,452,916	....	278,366
Portage	101,240	150,678	100,266	109,794	101,050	....	8,744
Stark	1,116,524	896,996	1,080,429	910,865	768,113	....	142,752
Summit	109,355	106,988	67,442	42,118	89,985	47,867	....
Trumbull	14,099	8,506	12,030	10,652	12,900	2,248	....
Tuscarawas	1,260,588	1,510,462	1,578,610	1,279,636	1,552,065	272,429	....
Vinton	68,901	46,880	92,441	192,069	206,622	14,553	....
Washington	5,300	3,010	3,604	3,600	9,550	5,950	....
Wayne	16,357	27,540	78,390	69,870	81,369	11,499	....
Noble, Scioto	[a]58,367	64,675	14,596	[b]8,681	90,963	82,282	....
Small mines	500,000	500,000	([c])	13,536	18,681	5,145	....
Total	18,988,150	20,943,807	23,519,894	24,838,103	24,434,812	....	[d]403,291

[a] Includes Geauga County.
[b] No production in Noble County.
[c] Small mines production included in county distribution.
[d] Net decrease.

One of the early reports published by Ohio states that in 1838 there were 119,952 short tons produced from the coal mines of the State. It is probable that some coal was mined in Ohio prior to that date, but we have no record of such production. The United States census of 1840 credited Ohio with an output of 140,536 tons. The census of 1850 did not consider the coal-mining industry, and the next report we have of coal production in the State was that of the census of 1860, which recorded an output of 1,265,600 short tons. Since that date the records of production are complete.

Annual coal production of Ohio, 1838–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1838	119,952	1872	5,315,294
1839	125,000	1873	4,550,028
1840 [a]	140,536	1874	3,267,585
1841	160,000	1875	4,864,259
1842	225,000	1876	3,500,000
1843	280,000	1877	5,250,000
1844	340,000	1878	5,500,000
1845	390,000	1879	6,000,000
1846	420,000	1880 [a]	6,008,595
1847	480,000	1881	9,240,000
1848	540,000	1882	9,450,000
1849	600,000	1883	8,229,429
1850	640,000	1884	7,640,062
1851	670,000	1885	7,816,179
1852	700,000	1886	8,435,211
1853	760,000	1887	10,300,708
1854	800,000	1888	10,910,951
1855	890,000	1889	9,976,787
1856	930,000	1890	11,494,506
1857	975,000	1891	12,868,683
1858	1,000,000	1892	13,562,927
1859	1,060,000	1893	13,253,646
1860 [a]	1,265,600	1894	11,909,856
1861	1,150,000	1895	13,355,806
1862	1,200,000	1896	12,875,202
1863	1,204,581	1897	12,196,942
1864	1,815,622	1898	14,516,867
1865	1,536,218	1899	16,500,270
1866	1,887,424	1900	18,988,150
1867	2,092,334	1901	20,943,807
1868	2,475,844	1902	23,519,894
1869	2,461,986	1903	24,838,103
1870 [a]	2,527,285	1904	24,434,812
1871	4,000,000		

[a] United States census, fiscal year.

OREGON.

Total production in 1904, 111,540 short tons; spot value, $243,588.

The only productive coal field in Oregon is situated in the southwestern part of the State in Coos County, and is known as the Coos Bay field from the fact that it entirely surrounds that body of water. It occupies a total area of about 250 square miles, its length north and south being about 30 miles and its maximum breadth at the middle about 11 miles, tapering regularly toward both ends. Other coal fields have been prospected in different parts of the State, and some have been shown to contain coal of fairly good quality. Among these are the Upper Nehalem, in Columbia County, the Lower Nehalem field, in Clatsop County and Tillamook County, the Yaquina field, in Lincoln County, and the Eckley and Shasta Costa fields, in Curry County. All of these fields lie west of the Cascade Range, but none has been developed to the point of production. Another field has been located in the basin of the John Day River, east of the Cascade Range, but little is known concerning it. All of the fields west of the range, with the exception of the Coos Bay, are of limited area, the largest, outside of the Coos Bay, being the Upper Nehalem, which has an area of less than 20 miles. All of the coal of these fields is lignitic in character. Transportation is confined exclusively to Coos Bay and the Pacific Ocean, and San Francisco is the principal market. The Coos Bay field is divided by its structure into six portions—four basins and two arches. The basins are known as the Newport, the Beaver Slough, the Coquille, and the South Slough, and are separated by the Westport and Pulaski arches. The principal development has been in the Newport Basin, so named from the Newport mine, which is the most important producer.

Coal was first noted in the Coos Bay region about fifty years ago, Prof. N. S. Newberry having reported in 1855 that the coal deposits of Coos Bay had begun to attract attention. It is known that some mining was done there in 1855 and 1872, and in 1876 two mines, the Eastport and the Newport, were in active operation. The Newport, however, is the only one to survive. The census of 1880 reports the total production of the State at 43,205 tons, this being the earliest record of such production. The total production has exceeded 100,000 tons in three years only—1896, 1897, and 1904—the maximum being maintained last year, when it reached 111,540 tons.

The statistics of production since 1892, with the distribution of the product for consumption, and the total production since 1880, are shown in the following tables:

Distribution of the coal product in Oregon, 1892–1904.

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	258
1904	79,293	13,968	18,279	111,540	243,588	734	284

[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, 1880–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1880	[a] 43,205	1893	41,683
1881	33,600	1894	47,521
1882	35,000	1895	73,685
1883	40,000	1896	101,721
1884	45,000	1897	107,289
1885	50,000	1898	58,184
1886	45,000	1899	86,888
1887	37,696	1900	58,864
1888	75,000	1901	69,011
1889	64,359	1902	65,648
1890	61,514	1903	91,144
1891	51,826	1904	111,540
1892	34,661		

[a] United States census, fiscal year.

PENNSYLVANIA.

Total production in 1904, 171,108,976 short tons; spot value, $233,408,239.

Anthracite.—Total production in 1904, 65,318,490 long tons; spot value, $138,974,020.

Bituminous.—Total production in 1904, 97,952,267 short tons; spot value, $94,434,219.

Following the unprecedented activity which prevailed throughout the coal-mining regions of Pennsylvania, both anthracite and bituminous, in 1903, the record for 1904 indicates a return to normal conditions and, from the consumers' standpoint, a more satisfactory one. The fuel famine induced by the strike in the anthracite mines in 1902 extended into the following year, and Pennsylvania, more than any other State, received the benefits of a largely increased production above the normal output, accompanied by the highest prices recorded in either anthracite or bituminous circles. The production of anthracite increased from 36,940,710 long tons in 1902 and 60,242,560 long tons in 1901 to 66,613,454 long tons in 1903. The average price per ton advanced from $2.05 in 1901 to $2.35 in 1902 and $2.50 in 1903, the total value of the product in 1903 being double that of 1902.

The production of bituminous coal increased from 82,305,946 short tons in 1901 to 98,574,367 short tons in 1902 (this being caused by the shortage of anthracite), and to 103,117,178 short tons in 1903, the price advancing from 99 cents per ton in 1901 to $1.08 in 1902 and $1.18 in 1903. The returns for 1904 show a decrease of 1,294,964 long tons in the production of anthracite and of 5,164,911 short tons in the output of bituminous coal. The average price of anthracite dropped from $2.50 to $2.35 per long ton and the total value decreased from $152,036,448 to $138,974,020, while the average price for bituminous coal declined from $1.18 to 96 cents per short ton, the total value decreasing from $121,752,759 to $94,434,219.

The rapid growth of the bituminous coal production, compared with that of anthracite during recent years, has been marked and forms one of the interesting features connected with the statistics of the coal-mining industry. Attention has been called to this in some of the previous reports of this series, and the following table has been prepared, showing the average production of Pennsylvania anthracite and of bituminous coal throughout the United States by five-year periods for the twenty-five years from 1876 to 1900, inclusive, and for the four years from 1901 to 1904, inclusive. It will be seen from this table that the average production of anthracite during the four years 1901–1904 was 2.49 times the average yearly production from 1876 to 1880, and that bituminous production for the later period was 7.19 times that of the earlier.

From 1876 to 1880 the average production of bituminous coal was 1.41 times that of anthracite, while from 1901 to 1904 bituminous production was four times that of hard coal. The reason for this comparatively great gain in bituminous production is not difficult to understand. For a number of years anthracite has been practically eliminated as a fuel for manufacturing purposes and its use has been almost entirely restricted to domestic consumption in the eastern States. And even for domestic purposes the products of bituminous coal—coke and gas—are competing more and more with anthracite in the markets of the larger cities and towns. Add to this the constantly increasing costs in the mining and preparation of anthracite and ample reason is furnished for the existing statistical situation.

Production of anthracite and bituminous coal since 1876 by five-year averages.

[Short tons.]

Period.	Anthracite, quantity.	Bituminous, quantity.
1876–1880	25,800,169	36,460,776
1881–1885	36,198,188	71,092,930
1886–1890	43,951,763	94,446,451
1891–1895	53,405,187	125,416,327
1896–1900	55,625,265	171,498,143
1901–1904 (4 years)	64,152,260	261,981,431

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, and in 1904 Pennsylvania's percentage of the total was 49. 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, 1880-1904.

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	49.7
1904	352,310,427	171,108,976	49

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 three 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 prosperous condition which was so marked in the anthracite industry in the year 1903 continued during 1904, although the total production for the latter year was not so great. The falling off in the product, however, was more apparent than real, as during the early part of 1903, in the months immediately following the strike of the previous year, every ton of available coal was rushed to market to supply the great demand at that time. As was noted in the report for the year 1903, the stocks of anthracite coal in all parts of the country were completely exhausted during the strike, and the demand from November, 1902, to the middle of 1903 was much greater than the capacity of the collieries to supply it. In addition to this, dealers at all points naturally attempted to provide adequate stocks for the winter of 1903–4, but the severity of the weather during this winter was such as to completely exhaust all supplies of the domestic sizes.

The year 1904, therefore, started with a good demand for domestic sizes, although there was considerable stock of small coal held in storage. The cold weather continuing well on in the spring made the late winter and early spring demand for coal exceptionally good, and throughout the entire year the collieries were practically worked to their full capacity.

The heavy demand during the year resulted in good prices being realized on all domestic sizes. This, however, was not true to the same extent of the small coals on account of the keen competition of bituminous coal. However, the average price per ton realized on the entire product of anthracite was fairly satisfactory, although 15 cents below that for the year 1903.

In connection with the comment made on the demand for the domestic sizes, as compared with the small sizes, attention is directed to the following figures showing the proportion of the sizes above pea coal shipped to market as compared with those below, for the last fifteen years. It will be seen from these figures that last year 38 per cent of the shipments consisted of pea coal and smaller, while in 1890 the small sizes were only 23 per cent.

Shipments of anthracite, according to sizes, since 1890.

Year.	Sizes above pea.		Pea and smaller.		Total shipments.
	Quantity.	Per cent.	Quantity.	Per cent.	
	Long tons.		*Long tons.*		*Long tons.*
1890	28,154,678	76.9	8,460,781	23.1	36,615,459
1891	30,604,566	75.7	9,843,770	24.3	40,448,336
1892	31,868,278	76.0	10,025,042	24.0	41,893,320
1893	32,294,233	74.9	10,795,304	25.1	43,089,537
1894	30,482,203	73.7	10,908,997	26.3	41,391,200
1895	32,469,367	69.9	14,042,110	30.1	46,511,477
1896	30,354,797	70.3	12,822,688	29.7	43,177,485
1897	28,510,370	68.5	13,127,494	31.5	41,637,864
1898	28,198,532	67.3	13,701,219	32.7	41,899,751
1899	31,506,700	66.1	16,158,504	33.9	47,665,204
1900	29,162,459	64.7	15,945,025	35.3	45,107,484
1901	34,412,974	64.2	19,155,627	35.8	53,568,601
1902	19,025,632	61.0	12,175,258	39.0	31,200,890
1903	37,738,510	63.6	21,624,321	36.4	59,362,831
1904	35,636,661	62.0	21,855,861	38.0	57,492,522

The total production during 1904 was 65,318,490 long tons of 2,240 pounds. Of this, 57,727,178 tons were shipped to market, 1,410,703 tons sold to local trade and employees at the mines, and 6,180,609 tons used for steam and heat.

The value of the product at the mines was $138,974,020. In placing this valuation no account is taken of coal used under the boilers for steam and heat, as this is largely culm, an otherwise wasted product.

The average number of men employed in anthracite operations during the year 1904 was 155,861, working an average of 200 days.

The following figures give a comparison of the production, value, men employed, and days worked during the last four years:

Statistics of anthracite production, 1901–1904.

Year.	Quantity.	Value.	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
1904	65,318,490	138,974,020	2.35	155,861	200

In the following tables are shown the production of the several counties embraced in the anthracite fields, divided according to shipments, sold to local trade, and used for steam and heat at the mines, for the years 1903 and 1904:

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

Anthracite production in 1904, by counties.

[Long tons.]

County.	Shipments.	Local trade.	Steam and heat.	Total.
Susquehanna	577,079	8,440	32,731	618,250
Lackawanna	15,703,059	424,359	1,082,305	17,209,723
Luzerne	21,678,253	589,932	2,190,594	24,458,779
Carbon	1,744,543	30,338	228,808	2,003,689
Schuylkill	12,149,852	212,461	1,810,980	14,173,293
Columbia	926,571	16,069	85,595	1,028,235
Sullivan	234,656	4,876	23,241	262,773
Northumberland	4,249,306	101,406	567,130	4,917,842
Dauphin	463,859	22,822	159,225	645,906
Total	57,727,178	1,410,703	6,180,609	65,318,490

In connection with the shipments of coal to market, a table is given below showing a division of this coal according to sizes for the years 1903 and 1904.

Shipments of anthracite according to sizes in 1903 and 1904.

[Long tons.]

Size.	1903.		1904.	
	Quantity.	Per cent.	Quantity.	Per cent.
Lump	2,203,116	3.71	1,447,549	2.52
Broken	4,825,497	8.13	3,979,062	6.92
Egg	7,917,689	13.34	7,600,002	13.22
Stove	11,591,573	19.52	11,282,077	19.63
Chestnut	11,200,635	18.87	11,327,971	19.70
Pea	7,929,715	13.36	8,057,268	14.01
Buckwheat No. 1	8,180,880	13.78	7.894,145	13.73
Smaller than Buckwheat No. 1	5,513,726	9.29	5,904,448	10.27
Total	59,362,831	100.00	57,492,522	100.00

In these shipments is included the production of the washeries, the greater part of which is reclaimed from the culm banks. The amount of this coal has, generally speaking, been growing from year to year, although in 1904 it was less by 868,910 tons than in 1903. This decrease was due to the unusually large output of the washeries during 1903. As compared with 1901, when there was a normal production of washery coal, the returns for 1904 show a gain of 233,131 tons.

The amount of this washery product by years since 1890 is shown in the following table:

Shipments of anthracite from washeries compared with total shipments, 1890–1904.

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	2.52
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
1904	2,800,466	57,492,522	4.87

In order to continue the record of anthracite business from the earliest date to the present time, the following table shows the shipments of coal from each region from 1820 to 1904, 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. Neither do they include shipments from Sullivan County mines, for reasons given further along in this report.

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1904.

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, 1820-1904—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

a Includes Loyalsock field.

Annual shipments from the Schuylkill, Lehigh, and Wyoming regions, 1820–1904—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.*
1886	9,381,407	29.19	5,723,129	17.89	a 17,031,826	52.82	32,136,362
1887	10,609,028	30.63	4,347,061	12.55	a 19,684,929	56.82	34,641,018
1888	10,654,116	27.93	5,639,236	14.78	a 21,852,366	57.29	38,145,718
1889	10,486,185	29.28	6,294,073	17.57	a 19,036,835	53.15	35,817,093
1890	10,867,822	29.68	6,329,658	17.28	a 19,417,979	53.04	36,615,459
1891	12,741,258	31.50	6,381,838	15.78	21,325,240	52.72	40,448,336
1892	12,626,784	30.14	6,451,076	15.40	22,815,480	54.46	41,893,340
1893	12,357,444	28.68	6,892,352	15.99	23,839,741	55.33	43,089,537
1894	12,035,005	29.08	6,705,434	16.20	22,650,761	54.72	41,391,200
1895	14,269,932	30.68	7,298,124	15.69	24,943,421	56.63	46,511,477
1896	13,097,571	30.34	6,490,441	15.03	23,589,473	54.63	43,177,485
1897	12,181,061	29.26	6,249,540	15.00	23,207,263	55.74	41,637,864
1898	12,078,875	28.83	6,253,109	14.92	23,567,767	56.25	41,899,751
1899	14,199,009	29.79	6,887,909	14.45	26,578,286	55.76	47,665,204
1900	13,502,732	29.94	6,918,627	15.33	24,686,125	54.73	45,107,484
1901	16,019,591	29.92	7,211,974	13.45	30,337,036	56.63	53,568,601
1902	8,471,391	27.15	3,470,736	11.12	19,258,763	61.73	31,200,890
1903	16,474,790	27.75	7,164,783	12.07	35,723,258	60.18	59,362,831
1904	16,379,293	28.49	7,107,220	12.36	34,006,009	59.15	57,492,522
Total	450,798,432	32.82	226,311,557	16.47	696,527,523	50.71	1,373,637,512

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:

Anthracite coal fields, by field, local district, and trade region.

Coal field or basin.	Local district.	Trade region.
Northern	Carbondale	Wyoming.
	Scranton	
	Pittston	
	Wilkesbarre	
	Plymouth	
	Kingston	
Eastern middle	Green Mountain	Lehigh.
	Black Creek	
	Hazleton	
	Beaver Meadow	
Southern	Panther Creek	Schuylkill.
	East Schuylkill	
	West Schuylkill	
	Lorberry	
	Lykens Valley	
Western middle	East Mahanoy	
	West Mahanoy	
	Shamokin	

The above-named fields comprise an area of something over 480 square miles, and are located in the eastern-middle part of the State, in the counties of Carbon, Columbia, 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 much 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 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.

The bituminous coal field of Pennsylvania includes an area of about 12,200 square miles in the western part of the State.

The coal-bearing rocks lie in the form of a basin or trough, the deepest part of which follows approximately the course of the Ohio River from near the southwest corner of the State to Huntington, W. Va. Beside the principal basin structure the rocks are thrown into many minor wrinkles which run in a general way parallel with the Allegheny front, and diminish from folds of considerable magnitude on the east to gentle undulations on the west.

The great bulk of the coal mined in the State comes from the Allegheny and Monongahela formations, which formerly were known as the Lower and Upper Productive Measures.

The Allegheny formation contains two coals that generally are of workable thickness. These are the Lower Kittanning and Upper

Freeport beds. Five other beds locally are of sufficient importance to mine. These are Brookville, Clarion, Middle Kittanning, Upper Kittanning, and Lower Freeport. The latter group are generally thin and unimportant and they add little to the coal production of the State. Except that in the Clearfield district, the original Moshannon is Bed D, or Lower Freeport, and this famous bed has long furnished a large amount of very excellent fuel. At the present time it is still largely worked in Cambria County, but Clearfield coal now includes coal from four or five distinct beds of this formation.

The Lower Kittanning is the most regular and persistent coal bed in the Allegheny formation and is mined in almost all counties located on or near the margin of the coal field. The Upper Freeport coal bed is extensively mined, but it lies higher in the series and is mined more in the interior of the basin.

More than half the production of the State is from the Pittsburg coal bed, which is mined most extensively in Allegheny, Fayette, Washington, and Westmoreland counties. This coal bed is limited to the southwest corner of the State, and it is mined in a large way in all of this territory, except in Greene County. In this county it lies far below the surface, and for that reason it has not been mined to any extent. As the demand increases this field will be drawn upon for supplies, but at present mining under the conditions prevailing here is not profitable, and the coal remains as a reserve supply.

The bituminous-coal production of Pennsylvania for 1904 records the first instance of a decrease since 1896. Stimulated by the scarcity of fuel produced by the strike in the anthracite region in 1902, the production from the bituminous districts of the State in that year and in 1903 was abnormally increased, so that the smaller production in 1904, like that of anthracite, is more apparent than real. Compared with 1901, when conditions were normal, the production in 1904 shows an increase of about 15,500,000 short tons, which would be in keeping with the average growth during recent years.

The total production of bituminous coal in Pennsylvania in 1904, as reported to the United States Geological Survey, was 97,952,267 short tons, valued at $94,434,219, which, compared with 1903, when the output was 103,117,178 short tons, worth $121,752,759, shows a decrease of 5,164,911 short tons, or 5 per cent, in quantity, and of $27,318,540, or 22.4 per cent, in value. The average price per ton declined from $1.18 to 96 cents.

As was the case generally throughout the coal-producing States, the returns from Pennsylvania show increases in the number of employees in both the anthracite and bituminous regions, in spite of decreased production in each. The number of men employed in the bituminous mines of the State increased from 129,265 in 1903 to 135,125 in 1904, while the average working time decreased from 235 days in 1903 to 196 days in 1904. From this it is seen that the average production per man for 1904 was 724.9 tons, as compared with 798 tons in 1903, while the average daily tonnage per man increased from 3.4 to 3.7. In 1902 the average production per man was 3.52 tons per day and 875 for the year.

The majority of the bituminous mines in Pennsylvania worked 8 hours a day during 1904; 637 mines, employing 77,960 men, or considerably more than 50 per cent of the total, reporting 8 hours as the length of the working day. A nine-hour day was reported at 223 mines employing a total of 24,972 men, and 187 mines with 30,286 men reported 10 hours. A few mines reported 7 hours. There was a decrease of nearly 2,000,000 tons in the machine-mined product in 1904 as compared with that so mined in 1903. In 1903, 37,146,253 short tons, or 36.02 per cent of the total output, was undercut by machines, while in 1904, although the number of machines in use showed an increase from 3,310 to 3,645, the machine-mined tonnage decreased to 35,174,613 or 35.91 per cent of the total product.

During 1904 there were 56 mines in the bituminous fields of Pennsylvania in which strikes occurred; but although the total time lost by them was a little more than one and three-quarters times the total number of days lost for the same reason in 1903, it was not enough to exert any influence on the total production. The total number of men on strike at the 56 mines in 1904 was 9,336, and the total time lost amounted to 576,353 working days, an average of 62 days for each man, and about 2.2 per cent of the total time made by all employees. In 1903, 12,805 men were on strike for an average of 25 days each, entailing a total loss of 321,925 days.

Twenty-five counties contributed to the bituminous-coal product of Pennsylvania in 1904. Of these, four, namely, Allegheny, Cambria, Fayette, and Westmoreland, each produced over 10,000,000 tons, and the last two each produced more coal in 1904 than any State except Ohio, Illinois, and West Virginia. Of the total bituminous output in Pennsylvania 20,868,368 tons were made into coke, a decrease from 21,694,308 tons of coal coked in 1903.

The statistics of production by counties in 1903 and 1904, with the distribution of the product for consumption, are shown in the following tables:

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 ton.	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	$15,505,866	$1.22	226	17,108
Armstrong	1,849,074	31,371	40,139	....	1,920,584	2,152,510	1.12	233	3,105
Beaver	165,954	12,808	1,340	....	180,102	262,140	1.46	239	477
Bedford	762,808	6,505	8,611	148,410	926,334	1,216,393	1.31	221	1,656
Blair	164,628	5,639	7,638	131,831	309,736	459,582	1.48	196	528
Butler	599,152	35,880	14,001	....	649,033	816,878	1.26	212	1,293
Cambria	9,553,107	233,326	209,880	946,183	10,942,496	13,693,752	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	1,447,413	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	898
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	8,159
Tioga	868,744	29,802	7,142	....	905,688	1,495,955	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
Westmoreland	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	981
Small mines	....	6,511	....	....	6,511	8,201	......	......	....
Total	77,987,351	1,572,156	1,863,363	21,694,308	103,117,178	121,752,759	1.18	235	129,265

[a] Cameron, Clinton, Greene, and Lycoming.

Bituminous coal production of Pennsylvania in 1904, 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	11,772,459	340,966	177,836	....	12,291,261	$12,569,768	$1.02	197	19,302
Armstrong	1,921,759	37,374	43,693	1,335	2,004,161	1,936,247	.97	223	3,167
Beaver	48,708	18,605	610	....	67,923	83,098	1.22	223	215
Bedford	412,861	6,892	5,666	115,431	540,850	545,644	1.01	150	1,210
Blair	211,159	2,695	2,082	28,996	244,932	271,020	1.11	179	560
Butler	460,318	23,855	13,143	....	497,316	515,374	1.04	161	1,235
Cambria	9,571,748	249,605	201,512	822,695	10,845,560	11,242,889	1.04	211	18,247
Center	706,980	3,660	1,396	....	712,036	699,236	.98	136	1,401
Clarion	520,938	12,903	17,691	....	551,532	529,611	.96	170	1,339
Clearfield	5,516,586	89,735	109,616	30,933	5,746,870	5,518,757	.96	187	10,992
Elk	1,016,915	32,562	24,253	55,501	1,129,231	1,003,098	.89	176	1,920
Fayette	5,980,308	270,404	427,519	12,552,780	19,231,011	16,585,466	.86	241	16,830
Huntingdon	469,852	8,221	9,150	....	487,223	520,927	1.07	233	838
Indiana	2,532,433	17,961	60,910	72,647	2,683,951	2,477,886	.92	236	4,468
Jefferson	4,710,804	16,685	44,415	1,271,660	6,043,564	5,847,580	.97	250	7,653
Lawrence	164,952	12,642	5,068	....	182,662	228,130	1.25	160	512
Mercer	588,482	4,292	26,874	....	619,648	621,330	1.00	178	1,287
Somerset	5,148,867	11,709	155,165	1,420	5,317,161	5,597,165	1.05	229	7,411
Tioga	582,215	28,997	5,616	....	616,828	930,711	1.51	151	1,742
Washington	8,584,035	100,544	211,064	4,611	8,900,254	8,361,326	.94	186	12,616
Westmoreland	12,160,494	222,148	430,290	5,882,522	18,695,454	17,773,790	.95	125	21,288
Other counties[a]	494,076	5,284	5,795	27,837	532,992	563,222	1.06	255	892
Small mines	....	9,847	....	....	9,847	11,941	......	....	....
Total	73,576,949	1,527,586	1,979,364	20,868,368	97,952,267	94,434,219	.96	196	135,125

[a] Cameron, Clinton, Greene, and Lycoming.

Of the 25 counties producing bituminous coal in Pennsylvania in 1904, there were only 5 in which the production exceeded that of 1903, while 20 showed decreases. The most notable decrease was in Clearfield County, whose output fell off 1,715,812 short tons, or 23 per cent. Next to this came Somerset County with a decrease of 640,590 tons. Westmoreland and Jefferson each lost a little over 430,000 tons and Fayette County over 380,000 tons. The most important gain was made by Indiana County, whose production increased 640,811 tons. The following table shows the increases and decreases by counties in 1904 as compared with 1903 and a résumé of the production during the last five years:

Bituminous coal production of Pennsylvania, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase 1904.	Decrease 1904.
Allegheny	10,051,905	10,307,100	11,919,569	12,689,225	12,291,261	....	397,964
Armstrong	1,313,188	1,555,255	1,793,179	1,920,584	2,004,161	83,577	....
Beaver	262,398	176,012	225,162	180,102	67,923	....	112,179
Bedford	570,055	500,322	797,248	926,334	540,850	....	385,484
Blair	496,992	368,779	338,204	309,736	244,932	....	64,804
Bradford	32,065	22,189	....	....	....	....	....
Butler	221,704	269,161	454,166	649,033	497,316	....	151,717
Cambria	8,190,366	9,045,201	10,561,835	10,942,496	10,829,087	....	113,409
Center	932,265	839,512	1,000,598	759,458	712,036	....	47,422
Clarion	404,639	354,840	458,221	531,630	551,532	19,902	....
Clearfield	6,620,834	5,886,407	7,334,785	7,462,682	5,746,870	....	1,715,812
Clinton	288,881	306,228	365,732	403,543	341,967	....	61,576
Elk	926,403	1,007,314	756,182	1,339,281	1,129,231	....	210,050
Fayette	15,055,242	16,187,224	18,988,058	19,613,161	19,231,011	....	382,150
Greene	....	....	25,550	153,000	80,646	....	72,354
Huntingdon	368,942	374,529	460,485	500,647	487,223	....	13,424
Indiana	924,782	1,074,260	1,655,281	2,043,140	2,683,951	640,811	....
Jefferson	6,199,290	5,806,568	6,083,494	6,474,764	6,043,564	....	431,200
Lawrence	187,810	171,959	212,445	232,992	182,662	....	50,330
Lycoming	99,000	107,095	112,820	57,030	78,837	21,807	....
McKean	20,214	....	....	....	....	....	....
Mercer	528,070	577,338	628,713	704,747	619,648	....	85,099
Somerset	4,779,307	4,831,660	5,911,326	5,957,751	5,317,161	....	640,590
Tioga	931,301	861,072	1,149,849	905,688	616,828	....	288,860
Washington	4,856,138	5,910,621	8,529,954	9,216,267	8,900,254	....	316,013
Westmoreland	14,980,535	15,165,300	18,811,511	19,127,904	18,695,454	....	432,450
Small mines	600,000	600,000	(a)	[b] 15,983	[b] 41,389	25,406	....
Total	79,842,326	82,305,946	98,574,367	103,117,178	97,952,267	....	[c] 5,164,911

[a] Small mines production included in county distribution.
[b] Includes production of Cameron County.
[c] Net decrease.

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, has amounted to 1,448,233,213 short tons. The anthracite production from 1814 to the close of 1904 amounted to 1,696,963,748 short tons, showing that the total production of the State has been nearly evenly divided between the two grades.

Production of bituminous coal in Pennsylvania, 1840–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1840 a	464,826	1873	13,098,829
1841	475,000	1874	12,320,000
1842	500,000	1875	11,760,000
1843	650,000	1876	12,880,000
1844	675,000	1877	14,000,000
1845	700,000	1878	15,120,000
1846	760,000	1879	16,240,000
1847	399,840	1880 a	18,425,163
1848	500,000	1881	22,400,000
1849	750,000	1882	24,640,000
1850	1,000,000	1883	26,880,000
1851	1,200,000	1884	28,000,000
1852	1,400,000	1885	26,000,000
1853	1,500,000	1886	27,094,501
1854	1,650,000	1887	31,516,856
1855	1,780,000	1888	33,796,727
1856	1,850,000	1889	36,174,089
1857	2,000,000	1890	42,302,173
1858	2,200,000	1891	42,788,490
1859	2,400,000	1892	46,694,576
1860 a	2,690,786	1893	44,070,724
1861	3,200,000	1894	39,912,463
1862	4,000,000	1895	50,217,228
1863	5,000,000	1896	49,557,453
1864	5,839,000	1897	54,417,974
1865	6,350,000	1898	65,165,133
1866	6,800,000	1899	74,150,175
1867	7,300,000	1900	79,842,326
1868	7,500,000	1901	82,305,946
1869	6,750,000	1902	98,574,367
1870 a	7,798,518	1903	103,117,178
1871	9,040,565	1904	97,952,267
1872	11,695,040		

a United States census, fiscal year.

TENNESSEE.

Total production in 1904, 4,782,211 short tons; spot value, $5,642,393.

About 4,400 square miles of the State are underlain by Coal Measures and approximately half this area contains one or more beds of workable coal. The Coal Measures occupy a belt extending entirely across the State in a northeast-southwest direction. This belt has a width of 70 miles at the Kentucky line and is there practically continuous. At the Georgia-Alabama line its width is about 50 miles and only the highest land is occupied by Coal Measures, the valleys of the Tennessee River and its tributaries being cut in Lower Carboniferous formations.

The greater part of the workable coal occurs in three basins, namely, the Wartburg, Walden, and Sewanee.

The Wartburg basin lies north of Emory River embracing portions of Scott, Anderson, and Morgan counties. It is continuous northward with the Jellico basin, which lies partly in Tennessee and partly in Kentucky. The central portion of the Wartburg basin is a deeply dissected plateau, and its coal is almost entirely undeveloped. Only two beds are at present worked and these only about the margins. The higher of these is in the Wartburg sandstone and the lower probably corresponding with the Sewanee bed farther south in the underlying Briceville shale. The latter coal bed averages about 4 feet in thickness on the eastern margin of the basin, decreasing to 3 feet at its western edge. There are in addition to these two numerous undeveloped beds, several of which are known to be of workable thickness.

The Walden basin extends southwestward from Emory River to the Georgia line. It is a narrow, unsymmetrical syncline—the beds having a steep dip on the eastern and a gentle dip on the western margins. The Walden basin contains several workable coal beds, the most important of which is identified with the Sewanee. The development has thus far been confined chiefly to the eastern margin where streams flowing from the Walden plateau have cut narrow gorges through the sharply upturned strata, giving access to the lowest part of the syncline.

The Sewanee basin is also long and narrow and extends parallel with the Walden basin, being separated from the latter by the Sequatchie Valley. The strata are practically horizontal except along the margin of the Sequatchie Valley, where they are sharply upturned. This basin contains several coal beds, the most important of which is the Sewanee seam, which is exceptional for its uniformity of character over a very large area. It averages about 4 feet in thickness. The principal development has been along the western margin of the Sequatchie Valley and in the outliers of the coal bed occupying the summit of the Cumberland Plateau. By far the larger part of the basin is entirely undeveloped.

The workable coal in the three basins described above is chiefly in the Walden formation above the Lookout conglomerate. Locally one or more of the three coal beds which occur below the Lookout conglomerate attain workable thickness, and is highly esteemed as domestic fuel. These lower beds are developed chiefly at Bonair and in the vicinity of South Pittsburg.

Tennessee's coal production in 1904 amounted to 4,782,211 short tons, which, compared with 1903, when the production was 4,798,004 short tons, exhibits a decrease of 15,793 short tons, or 0.3 per cent. The value of the product at the mines decreased in somewhat greater ratio, from $5,979,830 to $5,642,393, a loss of $337,437, or 5.6 per cent. It is probable that the tonnage for 1904 would have shown a small increase over 1903 rather than a decrease but for a number of labor troubles at some of the more important mines. At one property 400 men were on strike for 155 days; at another the same number of men were idle for 90 days, while 2 mines, employing 200 and 185 men, respectively, were shut down for 90 days, and 1, employing 175 men, was idle for 80 days. Altogether, 2,391 men out of a total of 10,416 were idle for an average of 71 days each, the total time lost by strikes being equivalent to 8 per cent of the entire working time made during the year.

Notwithstanding the decreased production, the number of men employed in 1904 was 455 more than in 1903, the total showing an increase from 9,961 to 10,416. Of this increase 145 were convicts employed in the State mines at Petros. The average tonnage per man for the year was 459.1, as compared with 482 in 1903 and 501 in 1902. The daily production per man was 2.12 tons in 1904, 2.12 in 1903, and 2.18 in 1902. Most of the coal mines of Tennessee were operated on a 9-hour basis in 1904, 63 mines out of 97 that reported the working time giving 9 hours as the length of the working day. These 63 mines gave employment to 6,102 men. Twenty-four mines (including the State mine at Petros with 450 convicts), employing a total of 2,887 men, reported 10 hours, and 8 mines, having 657 men, reported 8 hours. Two mines, having 153 men, worked 6 hours a day.

Machines for undercutting coal were employed in 17 mines, and the number in use and the machine-mined tonnage show substantial increases over 1903. There were reported in use during 1904, 85 undercutting machines, with which a total of 440,618 tons of coal were mined, while in 1903, 304,602 tons were mined by 51 machines. Of the machines in use in 1904, 71 were of the pick or puncher type and 14 were chain machines.

The statistics of production in the last two years, with the distribution of the product for consumption, are shown in the following tables:

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	30,383	134,093	147,954	1.10	244	203
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	667,357	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	....	1,394	....	....	1,394	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.

Coal production of Tennessee in 1904, 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	614,601	8,226	7,282	....	630,109	$726,936	$1.15	217	1,574
Campbell	612,748	27,946	11,665	152,391	804,750	1,001,341	1.24	178	2,031
Claiborne	938,948	14,885	7,422	....	961,255	1,025,962	1.07	328	1,412
Cumberland	89,478	762	1,478	....	91,718	114,337	1.25	217	179
Grundy	312,127	6,215	987	37,890	357,219	412,819	1.16	216	718
Hamilton	152,169	7,187	2,500	90,879	252,735	276,653	1.09	215	696
Marion	343,883	5,204	3,104	36,414	388,605	490,519	1.26	233	792
Morgan	411,461	2,483	9,573	60,715	484,232	620,891	1.28	252	1,121
Rhea	61,428	13,509	5,537	124,518	204,992	220,010	1.07	260	382
Scott	115,552	3,861	1,860	2,205	123,478	155,164	1.26	170	418
Other counties [a]	355,494	15,229	12,227	97,868	480,818	593,946	1.24	236	1,093
Small mines	....	2,300	....	....	2,300	3,815	....	....	....
Total	4,007,889	107,807	63,635	602,880	4,782,211	5,642,393	1.18	217	10,416

[a] Bledsoe, Fentress, Franklin, Overton, Roane, Sequatchie, and White.

In the following table is presented a statement of the production of coal in Tennessee during the last five years, with the increases and decreases in 1904 as compared with 1903:

Coal production of Tennessee, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase, 1904.	Decrease, 1904.
Anderson	672,752	664,409	759,276	655,721	630,109	....	25,612
Campbell	502,991	570,343	654,165	700,368	804,750	104,382	....
Claiborne	392,699	451,590	748,765	784,628	961,255	176,627	....
Cumberland	88	55,327	109,582	134,093	91,718	....	42,375
Grundy	300,198	326,990	332,550	466,642	357,219	....	109,423
Hamilton	227,063	242,993	250,526	264,268	252,735	....	11,533
Marion	310,730	307,609	312,446	439,784	388,605	....	51,179
Morgan	388,142	367,004	469,642	524,485	484,232	....	40,253
Overton	....	....	....	83,340	106,403	23,063	....
Putnam	7,275	3,648	....	....	....	....	....
Rhea	210,528	183,005	239,697	231,689	204,992	....	26,697
Roane	181,753	159,221	152,947	129,480	98,519	....	30,961
Scott	100,338	102,654	98,529	142,424	123,478	....	18,946
White	210,505	192,226	182,501	167,900	149,286	....	18,614
Other counties and small mines	4,500	6,271	72,342	73,182	128,910	50,286	....
Total	3,509,562	3,633,290	4,382,968	4,798,004	4,782,211	....	[a] 15,793

[a] Net decrease.

The United States census of 1840 states that 558 short tons of coal were produced in Tennessee in that year. It is probable that very little was mined in the State prior to that date. By 1860 the production had increased to 165,300 tons, but after that date development was retarded by the civil war. Since 1880 the production of Tennessee has increased quite regularly, but not so rapidly as that of Alabama. The maximum production was reached in 1903, when a total of 4,798,004 tons was recorded.

Coal production of Tennessee, 1840–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1840[a]	558	1873	350,000
1841	600	1874	350,000
1842	1,000	1875	360,000
1843	4,500	1876	550,000
1844	10,000	1877	450,000
1845	18,000	1878	375,000
1846	25,000	1879	450,000
1847	30,000	1880[a]	495,131
1848	40,000	1881	840,000
1849	52,000	1882	850,000
1850	60,000	1883	1,000,000
1851	70,000	1884	1,200,000
1852	75,000	1885	1,440,957
1853	85,000	1886	1,714,290
1854	90,000	1887	1,900,000
1855	100,000	1888	1,967,297
1856	115,000	1889	1,925,689
1857	125,000	1890	2,169,585
1858	135,000	1891	2,413,678
1859	150,000	1892	2,092,064
1860[a]	165,300	1893	1,902,258
1861	150,000	1894	2,180,879
1862	140,000	1895	2,535,644
1863	100,000	1896	2,663,106
1864	100,000	1897	2,888,849
1865	100,000	1898	3,022,896
1866	100,000	1899	3,330,659
1867	110,000	1900	3,509,562
1868	125,000	1901	3,633,290
1869	130,000	1902	4,382,968
1870[a]	133,418	1903	4,798,004
1871	180,000	1904	4,782,211
1872	224,000		

[a] United States census, fiscal year.

TEXAS.

Total production in 1904, 1,195,944 short tons; spot value, $1,983,636.

The coals of Texas are found in three coal-bearing formations, the Tertiary, the Cretaceous, and the Carboniferous. In the north-central portion of the State are found the bituminous coals, in the field properly belonging to the Southwestern or Indian Territory-Arkansas fields, but separated from them by a barren area caused by the Wichita uplift. This is designated by Mr. Joseph A. Taff, in the Twenty-second Annual Report of the Geological Survey, as the North Texas coal field. It is about 250 miles in length, with an average width of about 45 miles, and contains approximately 11,000 square miles. The known coal-bearing strata are, however, much more limited, being confined to the central part of the entire field. The principal mining operations are in Wise, Palo Pinto, and Erath counties, with smaller ones in Eastland, Coleman, and Bowie counties. The coals of the Cretaceous formation occur in the southern portion of the State and mining operations are carried on at Eagle Pass, in Maverick County. Lignite beds of Tertiary origin extend entirely across the State from the eastern boundary at the Sabine River in a southwesterly direction to the Rio Grande. In the southwestern extremity, near Laredo, in Webb County, lignite approaches the bituminous in character and the Webb County production is classed as bituminous. Lignite mining operations have been carried on in Anderson, Bastrop, Houston, Medina, Milam, Raines, Robertson, Shelby, and Wood counties, the principal operations being in Medina, Milam, and Wood. During the last few years, or since the discoveries of oil at Beaumont, the lignite-producing industry has suffered greatly from the use of fuel oil, with which it comes into direct competition. Notwithstanding this, however, the production of lignite increased from 267,605 short tons in 1903 to 421,629 short tons in 1904, while the total production for the State increased from 926,759 short tons to 1,195,944 short tons a gain of 269,185 tons, or 29 per cent. The value increased from $1,505,383 to $1,983,636, a gain of $478,253, or nearly 32 per cent. The average price per ton for the bituminous product advanced from $1.96 to $2.13, while that of lignite declined from 81 cents to 78 cents.

There were 13 counties in that State that produced coal in 1904, an increase of 1 over the preceding year. Of the 13 counties, bituminous coal was mined in 7, while 6 produced lignite. The 7 bituminous-producing counties were Eastland, Erath, Maverick, Palo Pinto, Parker, Webb, and Wise; and those producing lignite were Bastrop, Houston, Medina, Milam, Shelby, and Wood.

The coal mines of Texas gave employment to 2,921 men in 1904, who made an average of 220 working days, against 2,380 men for 242 days, in 1903. The average production per man in 1904 was 409.4 tons, as compared with 389 tons in 1903, while the average daily production per man was 1.61 in 1903 and 1.86 in 1904. This increase in the average production per man was due to the larger production of lignite, in the mines of which, owing to the greater thickness of the beds, the productive capacity is more. In 1904 the average production of lignite per man was 628 tons and of bituminous coal 344 tons; in 1903 these averages were 579.2 and 343.7, respectively. In reporting their production to the United States Geological Survey for 1904, 12 mines, employing a total of 971 men, gave 10 hours as the length of the working day; 2 mines, employing 91 men, reported 9 hours; 7 mines, employing 1,624 men, worked 8 hours, and 2 mines, with 95 men, worked 6 hours.

During 1904 there were 9 undercutting machines in use, and of the total product 33,154 tons were machine mined. In 1903, 8 machines were used in the mining of 29,000 tons of coal.

Strikes occured in 2 mines during 1904, both being of short duration. In one instance 25 men were idle for 21 days, and in the other, which lasted but 2 days, 30 men were out.

In the following tables are presented the statistics of production in the last two years. Owing to the fact that there are only one or two mines in each county, the production of the bituminous-producing and the lignite-producing counties, respectively, are combined.

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, Parker, Webb, Wise	643,541	4,946	10,667	659,154	$1,289,110	$1.96	256	1,918
Lignite:								
Houston, Medina, Milam, Shelby, Wood	236,715	29,075	1,815	267,605	216,273	.81	181	462
Total	880,256	34,021	12,482	926,759	1,505,383	1.62	242	2,380

Coal production of Texas in 1904, 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, Parker, Webb, Wise	747,769	10,886	15,660	774,315	$1,652,992	$2.13	223	2,250
Lignite:								
Bastrop, Houston, Medina, Milam, Shelby, Wood	411,286	6,710	3,633	421,629	330,644	.78	211	671
Total	1,159,055	17,596	19,293	1,195,944	1,983,636	1.66	220	2,921

The Tenth United States Census for 1880 did not report any coal production in Texas, the first recorded production being for 1884, and published in Mineral Resources of the United States. The production reported for that year was 125,000 short tons. The growth of the industry since that date is shown in the following table:

Coal production of Texas, 1884–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1884	125,000	1895	484,959
1885	100,000	1896	544,015
1886	100,000	1897	639,341
1887	75,000	1898	686,734
1888	90,000	1899	883,832
1889	128,216	1900	968,373
1890	184,440	1901	1,107,953
1891	172,100	1902	901,912
1892	245,690	1903	926,759
1893	302,206	1904	1,195,944
1894	420,848		

UTAH.

Total production in 1904, 1,493,027 short tons; spot value, $1,943,440.

Like the other coal-producing States of the Rocky Mountain region, the coal fields of Utah are somewhat widely separated and contain somewhat limited areas. Even the known fields have been comparatively little explored, and it has been impossible to estimate the total productive area. The present known regions in Utah are estimated to contain about 2,000 square miles of workable coal.

The principal fields are the Wasatch and Coalville. The former occurs in the Wasatch Mountains, in Carbon and Emery counties, and extends in a comparatively narrow belt from the Colorado line in a westerly direction to the center of the State. The Coalville field is in Wasatch County, in the northeastern part of the State, near the Wyoming State line. Other known regions are the Ashley Creek area, the Provo Canyon area, the Southern Utah, and the Henry Mountain, in all of which but little work has been done, the small production obtained being for purely local use. All of the really large mining operations are in the Wasatch Mountains, in the western part of the Wasatch field, at Castle Gate, Winter Quarters, Pleasant Valley, and Sunnyside, all in Carbon County, which produces over 95 per cent of the coal output of the State. Most of the coal produced in Utah is bituminous in character and of Cretaceous age. Some of it makes a fair grade of coke, from 250,000 to 350,000 tons of the total product being so consumed in each year.

Utah's coal production in 1904 amounted to 1,493,027 short tons, valued at $1,943,440, against 1,681,409 tons, valued at $2,026,038 in 1903, indicating a decrease of 188,382 tons, or 11.2 per cent, in quantity, and of $82,598, or 4.1 per cent, in value. The average price per ton advanced from $1.20 to $1.30. The only cause for the decrease in production appears to have been a natural falling off in the demand, though it may have been due to a scarcity of labor, as a considerable decrease is shown in the number of men employed in 1904.

The statistics in regard to the use of mining machines show a decided falling off in 1904. In 1903 there were 13 machines in use, and 75,000 tons were machine mined, while in 1904 only 9 machines were reported, with a total of 34,054 tons mined by them. No strikes were reported at any of the Utah mines in 1904.

During 1904 there were 1,374 men employed in the coal mines of Utah, a decrease of 551 from 1,925 employees in 1903. The average number of days made by each employee increased from 248 to 294. In all of the important mines the men worked 8 hours per day, 15 mines with a total of 1,356 men reporting that length of working day.

Two small mines worked 9 hours, and one worked 10 hours. The average production per man during 1904 was 1,086.6 short tons, against 873 tons in 1903 and 862 tons in 1902. The average daily production per man was 3.7 tons in 1904, 3.52 in 1903, and 3.33 in 1902.

The statistics of production by counties in 1903 and 1904, with the distribution of the product for consumption, is shown in the following tables:

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

Coal production of Utah in 1904, 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	1,010,866	6,749	49,227	349,781	1,416,623	$1,820,351	$1.28	303	1,218
Emery		4,031			4,031	5,253	1.30	108	16
Morgan, Sanpete	5,014	2,719			7,733	14,432	1.87	201	28
Summit, Uinta	48,297	7,713	5,310		61,320	98,259	1.60	254	112
Small mines		3,320			3,320	5,145			
Total	1,064,177	24,532	54,537	349,781	1,493,027	1,943,440	1.30	294	1,374

The production, by counties, during the last five years and the increases and decreases in 1904 as compared with 1903 are shown in the following table:

Coal production of Utah, 1900-1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase 1904.	Decrease 1904.
Carbon	1,087,360	1,259,247	1,507,689	1,599,986	1,416,623	....	183,363
Emery	450	1,374	4,718	8,178	4,031	....	4,147
Iron	671	....	520	....	....	....	....
Morgan / Sanpete	4,015	3,030	8,531	7,296	7,733	437	....
Summit / Uinta	54,531	58,963	53,063	64,054	61,320	....	2,734
Small mines	....	....	....	1,895	3,320	1,425	....
Total	1,147,027	1,322,614	1,574,521	1,681,409	1,493,027	....	[a] 188,382

[a] Net decrease.

The United States census of 1870 credits Utah with a production of 5,800 short tons, and the growth of the industry since that date is shown below:

Coal production of Utah, 1870-1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1870	5,800	1890	318,159
1876	50,400	1891	371,045
1877	50,400	1892	361,013
1878	67,200	1893	413,205
1879	50,000	1894	431,550
1880	14,748	1895	471,836
1881	52,000	1896	418,627
1882	100,000	1897	521,560
1883	200,000	1898	593,709
1884	200,000	1899	786,049
1885	213,120	1900	1,147,027
1886	200,000	1901	1,322,614
1887	180,021	1902	1,574,521
1888	258,961	1903	1,681,409
1889	236,651	1904	1,493,027

VIRGINIA.

Total production in 1904, 3,583,914 short tons; spot value, $3,076,011.

The first bituminous coal mined in the United States was taken from what is usually termed the Richmond basin, a small area of Triassic age in the southeastern portion of the State near the city of Richmond. This basin is situated on the eastern margin of the Piedmont Plateau, 13 miles above tide on the James River. It lies in Goochland, Henrico, Powhatan, and Chesterfield counties. The coal beds are much distorted, and the coal is of rather low grade when compared with that from other districts with which it has to come into competition. The mines are also gaseous, and since the coals from the New River district in West Virginia and other high-grade coals from other sources have been brought to the markets formerly supplied by coal from the Richmond basin the production has fallen off rapidly, until now only a small quantity is mined there annually.

The occurrence of coal was known in this district as early as 1700, and it was used in the latter quarter of the eighteenth century. In 1789 shipments were made to some of the northern States. In 1822, according to Mr. R. C. Taylor, the production amounted to 48,214 long or 54,000 short tons. During the latter part of the nineteenth century expensive but unsuccessful efforts were made to reestablish the industry in this field. The coal, however, could not be forced upon the market in competition with the higher-grade coals from other districts, and at the present time what little coal is produced there is for purely local consumption. With the completion of the Norfolk and Western Railroad, in 1882, the coal fields in the southwestern part of the State, which belong to the Appalachian System, were opened up. A portion of the famous Pocahontas district is included within the county of Tazewell, in Virginia, and the construction of the Clinch Valley branch of the Norfolk and Western Railroad, in 1891, opened up valuable coal lands in Wise County, which has since become the most important producing district in the State.

Two small outlying basins from the Appalachian fields are found in the State—one in Frederick County, at the north, and the other in Pulaski and Montgomery counties, at the south. In both the coal is of a semianthracite character, but the only developments on a practical scale have been made in the Pulaski-Montgomery basin. During 1904 a large amount of work in opening up was done in Montgomery County by the Virginia Anthracite Coal Company, and it appears probable that the county will become one of the important producers. Previous to 1904 all of the coal mined was from comparatively small mines, the product being consumed in the immediate vicinity.

Virginia is one of the few States whose coal production in 1904 showed an increase over the preceding year. In 1903 the coal production in this State amounted to 3,451,307 short tons, valued at $3,302,149; in 1904 it attained the maximum output in the State's history, 3,583,914 short tons, a gain of 132,607 short tons, or 3.8 per cent. With a decline in prices, however (from 96 cents in 1903 to 86 cents in 1904), the total value decreased from $3,302,149 to $3,076,011, a loss of $226,138, or 6.8 per cent.

The coal mines of Virginia gave employment in 1904 to 5,430 men, who made an average of 239 working days each, against 5,608 men for 267 days in 1903 and 3,912 men for 293 days in 1902. The average production per man in 1904 was 660 short tons, while in 1903 it was 615, and in 1902 814 tons. The average daily tonnage was 2.76 in 1904, 2.3 in 1903, and 2.78 in 1902. Most of the mines in Virginia work on a 10-hour basis. In 1904 24 mines, employing 4,092 men, worked 10 hours, 6 mines, employing 372 men, worked 9 hours, and 2 mines, having 256 men, worked 8 hours.

Mechanical production of coal in Virginia showed a decided increase in 1904 over both 1903 and 1902. Last year there were 18 machines in use, and the machine-mined product amounted to 245,536 short tons, against 10 machines and 82,040 tons in 1903, and 11 machines and 132,709 tons in 1902.

No labor troubles of any kind were reported from Virginia coal mines last year.

In the following tables are presented the statistics of production, by counties, in 1903 and 1904, with the distribution of the product for consumption:

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

Coal production of Virginia in 1904, 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	15,033	4,619	1,976	....	21,628	$45,555	$2.11	229	[a] 232
Tazewell	676,599	9,574	13,366	172,181	871,720	833,485	.91	247	1,088
Wise	1,034,158	27,366	47,786	1,404,823	2,514,133	2,024,752	.81	240	3,779
Chesterfield, Pulaski, Russell	170,050	3,126	2,957	....	176,133	171,669	.97	219	331
Small mines	....	300	....	....	300	550	......	....	....
Total	1,895,840	44,985	66,085	1,577,004	3,583,914	3,076,011	.86	239	5,430

[a] Seemingly large number of men employed due to extensive development work.

The statistics of production, by counties, during the last five years, with the increases and decreases in 1904 as compared with 1903, are shown in the following table:

Coal production of Virginia, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase 1904.	Decrease 1904.
Montgomery	9,814	11,177	12,786	20,288	21,628	1,340	....
Tazewell	970,866	776,568	723,753	840,195	871,720	31,525	....
Wise	1,363,570	1,918,693	2,422,417	2,563,285	2,514,133	....	49,152
Chesterfield, Henrico	40,178	11,760	16,206	18,084	2,100	....	15,984
Pulaski, Russell	9,326	7,675	7,831	9,255	174,033	164,778	....
Small mines	....	....	....	200	300	100	....
Total	2,393,754	2,725,873	3,182,993	3,451,307	3,583,914	[a] 132,607	....

[a] Net increase.

It has been stated that the first coal mined in the United States was from the Richmond basin in Virginia, and Mr. W. J. Nicolls, in his Story of American Coals, states that mines were opened and worked on the James River, near Richmond, in 1750. This antedates by nineteen years the first reliable record of the use of anthracite in Pennsylvania, but, unfortunately, Mr. Nicoll does not give his authority for the statement. Whatever production there may have been there is no record of the amount of coal produced prior to 1822, when, according to Mr. R. C. Taylor, in his Statistics of Coal, 54,000 short tons were mined.

At the taking of the United States census in 1840 Virginia was a comparatively important coal-producing State, the Piedmont region having been developed contemporaneously with the Maryland fields a few years before. With the separation of West Virginia from Virginia in 1863 the mother State was deprived of nearly all of her coal-bearing territory, though the enormous wealth contained therein was not known at that time. The production of coal fell off from 445,124 short tons in 1862 to 40,000 tons in 1863. There was not much increase over this output until 1882, when, with the completion of the Norfolk and Western Railroad, the Pocahontas-Flat Top region was opened up. In the early part of the following decade the Wise County fields were made available by the construction of the Clinch Valley division of the Norfolk and Western Railroad. The production has increased in every year but one since that date, reaching a total of over 3,500,000 short tons in 1904, as shown in the table following.

Coal production of Virginia, 1822–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1822	54,000	1864	40,000
1823	60,000	1865	40,000
1824	67,040	1866	40,000
1825	75,000	1867	50,000
1826	88,720	1868	59,051
1827	94,000	1869	65,000
1828	100,080	1870 [a]	61,803
1829	100,000	1871	70,000
1830	102,800	1872	69,440
1831	118,000	1873	67,200
1832	132,000	1874	70,000
1833	125,000	1875	60,000
1834	124,000	1876	55,000
1835	120,000	1877	50,000
1836	134,000	1878	50,000
1837	160,000	1879	45,000
1838	300,000	1880 [a]	43,079
1839	396,000	1881	50,000
1840 [a]	424,894	1882	112,000
1841	379,600	1883	252,000
1842	373,640	1884	336,000
1843	370,000	1885	567,000
1844	365,000	1886	684,951
1845	350,000	1887	825,263
1846	340,000	1888	1,073,000
1847	325,000	1889	865,786
1848	318,000	1890	784,011
1849	315,000	1891	736,399
1850	310,000	1892	675,205
1851	310,000	1893	820,339
1852	325,000	1894	1,299,083
1853	350,000	1895	1,368,324
1854	370,000	1896	1,254,723
1855	380,782	1897	1,528,302
1856	352,687	1898	1,815,274
1857	363,605	1899	2,105,791
1858	377,690	1900	2,393,754
1859	359,055	1901	2,725,873
1860 [a]	473,660	1902	3,182,993
1861	445,165	1903	3,451,307
1862	445,124	1904	3,583,914
1863	40,000		

[a] United States census, fiscal year.

WASHINGTON.

Total production in 1904, 3,137,681 short tons; spot value, $5,120,931.

The coal fields of Washington are confined to the western and central portions of the State. Four principal fields may be mentioned; the North Puget Sound field, including the coal mines of Skagit and Whatcom counties; the South Puget Sound field, containing the operations in King and Pierce counties; the Puget Sound basin, just east of Seattle; the Roslyn field, in Kittitas County, on the eastern slope of the Cascade Mountains, and the Southwestern field, embracing the counties of Lewis and Cowlitz.

The coals of Washington range from lignite to bituminous coking coals, and some natural coke has been observed. The bituminous coals of Washington are the only bituminous coking coals on the Pacific slope of the United States. The coking coals are found in the Wilkeson-Carbonado district, in the South Puget Sound field, in the Roslyn field, and in the North Puget Sound field. The Wilkeson-Carbonado coal runs high in ash and is usually washed before coking. The lignite coals of Newcastle and Renton, in the South Puget Sound field, are generally of high grade and well suited for domestic use.

Coal was first discovered in Washington in 1848, when a lignite of rather low grade was found in the Cowlitz Valley. Four years later bituminous coal was discovered on Bellingham Bay, Whatcom County, and the first mine in the State was opened on this bed. Shipments did not begin, however, until 1860. This mine was operated continuously from 1860 until 1878, when, because of a fire caused by spontaneous combustion, the workings were abandoned and they have not since been reopened. Shipments were not resumed from any of the mines in the northern district until thirteen years later—in 1891. Coal was discovered in King County in 1859, and mining began near the present Issaquah in 1862. Shipments to San Francisco began in 1871, since which time the Washington mines have been an important source of coal supply to the San Francisco market. About the same time the Talbot and Renton mines, which are in King County, began shipping, and rail connection between the Renton mines and Seattle was obtained in 1877. Production in the Green River field, also in King County, began between 1880 and 1885, and the Pierce County fields, which had been opened up in 1875 and afterwards abandoned, again began shipping about the same time. The Roslyn mines, on the east side of the Cascade Range, were opened in the first half of the same decade. The Bellingham Bay mines, in the first year of their recorded production—1860—shipped out 5,374 tons. In 1903, the year of maximum production, Washington's output of coal was 3,193,273 tons.

Compared with 1903, the coal production of Washington in 1904 shows a decrease of 55,592 short tons, or 1.7 per cent. The value of the product at the mines fell off from $5,380,679 in 1903 to $5,120,931 in 1904, a loss of $259,748, or 4.8 per cent. This decrease in production, and the proportionately larger decrease in value, were due to the much increased use of fuel oil in San Francisco and other California cities, which form one of the principal outlets for Washington coal.

There were only two cases of suspension of work by strikes in the coal mines of Washington in 1904. In these a total of 365 men were idle for an average of sixty-nine days, the total time lost being equivalent to 2 per cent of the total time worked, and not sufficient to affect the production for the year.

The number of men employed in the coal mines of Washington increased from 4,768 in 1903 to 5,287 in 1904, while the average number of days worked decreased from 285 to 243. Owing to the larger number of men employed in 1904, the average productive capacity per man for the year shows a decrease from 670 tons in 1903 to 593.5 tons in 1904; while due to the fewer number of days worked, the average daily efficiency shows an increase from 2.35 tons per man in 1903 to 2.44 tons in 1904. In 1902 the average daily tonnage per man was 2.22. Of the total number of coal mines in Washington, there were 7 mines employing 110 men that reported eight hours as the length of the working day; 17 mines, employing 4,042 men, reported eight hours for miners and either nine and one-half or ten hours for "day" men; 4 mines, employing 70 men, reported nine hours, and 6 mines, with 757 men, reported ten hours.

There have been no mining machines reported in use in the coal mines of this State during the last three years. The statistics of production in 1903 and 1904, with the distribution of the product for consumption, is shown in the following tables:

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	2,003
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	4,768

Coal production of Washington in 1904, 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	1,151,378	8,467	59,385	....	1,219,230	$2,005,384	$1.64	216	2,492
Kittitas	1,303,548	10,033	26,819	....	1,340,400	1,948,980	1.45	279	1,649
Pierce	424,756	3,626	25,972	77,235	531,589	1,065,337	2.00	266	990
Other counties[a] and small mines	31,930	6,480	8,052	....	46,462	101,230	2.15	138	156
Total	2,911,612	28,606	120,228	77,235	3,137,681	5,120,931	1.63	243	5,287

[a] Asotin, Cowlitz, Lewis, Skagit, Thurston, and Whatcom.

The total production for the State, by counties, during the last five years, with the increases and decreases in 1904 as compared with the preceding year, is shown in the following table:

Production of coal in Washington, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase, 1904.	Decrease, 1904.
Cowlitz	500	....	....	....	1,800	1,800	....
King	1,003,101	957,549	1,017,888	1,229,560	1,219,230	....	10,330
Kittitas	873,751	1,012,521	1,250,920	1,369,716	1,340,400	....	29,316
Lewis	300	520	826	1,410	1,335	....	75
Pierce	577,127	585,984	383,603	572,800	531,589	....	41,211
Skagit	10,130	12,643	21,967	19,115	10,650	....	8,465
Whatcom	9,184	9,000	6,010	672	1,837	1,165	....
Other counties	....	....	....	....	30,840	30,840	....
Total	2,474,093	2,578,217	2,681,214	3,193,273	3,137,681	....	[a] 55,592

[a] Net decrease.

The United States Census report for 1860 contains the first record of coal production in Washington. This production was entirely from the Bellingham Bay properties in Whatcom County, and amounted to 5,374 short tons. The State did not assume much importance as a coal producer, however, until the opening up of the Green River field in King County, between 1880 and 1885, and of the Roslyn mines in Kittitas County, which began producing about the same time. The growth of the industry since 1860, when production began, to the close of 1904 is shown in the table following.

Production of coal in Washington, 1860–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1860 [a]	5,374	1883	244,990
1861	6,000	1884	166,936
1862	7,000	1885	380,250
1863	8,000	1886	423,525
1864	10,000	1887	772,601
1865	12,000	1888	1,215,750
1866	13,000	1889	1,030,578
1867	14,500	1890	1,263,689
1868	15,000	1891	1,056,249
1869	16,200	1892	1,213,427
1870 [a]	17,844	1893	1,264,877
1871	20,000	1894	1,106,470
1872	23,000	1895	1,191,410
1873	26,000	1896	1,195,504
1874	30,352	1897	1,434,112
1875	99,568	1898	1,884,571
1876	110,342	1899	2,029,881
1877	120,896	1900	2,474,093
1878	131,660	1901	2,578,217
1879	142,666	1902	2,681,214
1880	145,015	1903	3,193,273
1881	196,000	1904	3,137,681
1882	177,340		

[a] United States census, fiscal year.

WEST VIRGINIA.

Total production in 1904, 32,602,819 short tons; spot value, $28,807,420.

Nearly 70 per cent of the area of West Virginia, or 17,280 out of a total of 24,780 square miles in the State, is included in the coal fields of the Appalachian system, which crosses the State from Pennsylvania and Maryland on the north to Virginia and Kentucky on the south. Only the area lying to the east of the escarpment of the Allegheny Mountains is outside of the coal-bearing rocks. All of the coals of West Virginia belong to the bituminous, or semibituminous varieties, but some cannel and a peculiar grade known as Kanawha splint are mined in the southern part of the State. One of the most important seams in the State is the celebrated Pittsburg bed of Pennsylvania, which extends over a considerable portion of West Virginia and Ohio.

Of West Virginia's total production fully 90 per cent comes from 5 principal mining districts, and nearly all of the other 10 per cent comes from 3 smaller districts. The more important of these are the Fairmont, or Clarksburg, and the Piedmont, or Elk Garden, fields in the northern portion of the State, and the New River, Kanawha, and Pocahontas fields in the southern portion.

The Fairmont, or Clarksburg, region lies principally in Harrison and Marion counties, the beds from which the coal is mined here belonging to the Upper Productive Coal Measures. The most important bed is the Pittsburg, which has an average thickness of 8 feet 6 inches, of which 7 feet are usually mined. The Waynesburg and Sewickley coals, the former poor and the latter good, also occur in this district and run from 5 to 10 feet in thickness, but are seldom mined. The field is penetrated by the Baltimore and Ohio Railroad, which furnishes transportation for the product.

The Piedmont, or Elk Garden, field was the first to be worked in West Virginia, coal having been mined in this district before the State was separated from the mother State of Virginia, and also contemporaneously with the opening of the Cumberland, or Georges Creek, field in Maryland. It is a part of the detached portion of the great coal fields lying in Mineral, Grant, and Tucker counties, where the coal beds are somewhat folded. The coal approaches semibituminous in character. Two coals belonging in the Lower Productive measures are worked. They are known as the "E," or Upper Freeport, and the "B," or Lower Kittanning, and range from 4 to 11 feet in thickness. Transportation is afforded by the Baltimore and Ohio and the West Virginia Central and Pittsburg railroads, the latter being now a portion of the Wabash System.

The New River field, as at present outlined, is confined to the valley of the New River and its tributaries, the productive portions being in Fayette and Raleigh counties. The coals of this district occur in the Lower Pottsville series, which lies below the Kittanning and Upper Productive Measures of the northern part of the State. The two beds which furnish the larger part of the product are the Sewell, which runs from 2 feet 6 inches to 5 feet, and the Quinnimont, from 3 to 5 feet in thickness, the latter lying below and to the southeast of the former. The coal is of the "smokeless" coking variety, not unlike in quality that of the Piedmont field. One seam of coal, belonging properly to the Kanawha field, lies high in the hills in the New River district, and is extensively mined at Ansted, in Fayette County. The district is penetrated by the Chesapeake and Ohio Railroad, which follows the course of the New River and furnishes transportation for the product.

The Kanawha field lies immediately west of the New River field and includes the western portion of Fayette County, all of Kanawha, and a portion of Putnam County. It is drained by the Kanawha and the Elk rivers. The coals of this field occur at a higher geologic horizon than those of the New River district and belong to the Lower Productive and Upper Pottsville Measures. The coals are variable in character and in thickness. The beds usually vary from 3 to 5 feet in thickness where mined, but in some cases reach as high as 11 feet or more in thickness. A considerable portion of the coal is a high-grade, gas-producing fuel, Kanawha gas coal having an excellent reputation for this purpose. The principal beds are designated as the No. 5 seam, the Coalburg, Cedar Grove, Campbells Creek, and Eagle. Transportation is furnished by the Chesapeake and Ohio, the Kanawha and Michigan, and the recently constructed Coal and Coke Railroad. The slack-water navigation of the Kanawha River also affords an outlet to market for the Kanawha coals.

The Pocahontas field lies in the southeastern corner of the State, in McDowell and Mercer counties, and extends across the State line into Tazewell County, Va. The coal mined in the Pocahontas, or No. 3 seam, is from 4 to 11 feet in thickness, averaging over 6 feet. It occurs near the bottom of the Pottsville series. The coal is a high-grade, semibituminous variety, one of the purest coals occurring in the United States. It is the only rival as a coke producer to the Connellsville coal of Pennsylvania, and as a steam fuel ranks with the Georges Creek Cumberland of Maryland and the best Clearfield coals of Pennsylvania. This district is penetrated by the Norfolk and Western Railroad, over which the product is shipped to market.

The smaller fields include the coals of the Big Sandy in Mingo County, in the southern portion of the State, this being in reality a continuation of the Kanawha field, with transportation afforded by the Norfolk and Western Railroad; the Philippi field, in Preston, Barbour, and Randolph counties, which belong to the Lower Productive Measures in the northern part of the State, and the Wheeling field, which includes the counties in the Pan Handle along the Ohio River and where the Pittsburg coal is mined.

Mr. Neil Robinson, M. E., of Charleston, W. Va., who has made a careful study of the coal resources of West Virginia and who has kept in touch with its development, states that, as nearly as can be determined from the data available, about 20 distinct seams are being mined in the State at the present time. Mr. Robinson has endeavored to obtain the statistics showing the productiveness of each of these seams, but this has been found impossible on account of the pardonable mistakes made by mine superintendents in correlating the seams they have opened. Each district has adopted a local nomenclature and the 20 beds actually worked carry 42 different names. Mr. Robinson writes further as follows:

The following series of the Carboniferous system are exposed in the State above water level:

	(According to Rogers.)
Monongahela	No. 15, or Upper Productive.
Conemaugh	No. 14, or Lower Barren.
Allegheny-Kanawha	No. 13, or Lower Productive.
Pottsville	No. 12, or Seral Conglomerate.

During the year ending June 30, 1904, according to the report of Mr. James W. Paul, chief mine inspector, the production by series was as follows:

	Coal mined.	Used in coke ovens.
	Short tons.	*Short tons.*
Monongahela (Pittsburg seams)	8,143,044	207,290
Conemaugh and Allegheny-Kanawha	9,754,795	924,395
Pottsville (Pocahontas and New River)	12,134,642	2,602,238
Total	30,032,481	3,733,923

Dr. I. C. White in his report on the mineral resources of the State estimates that we have "10,000 to 12,000 square miles of productive coal territory, reckoned by the standard of thickness and quality as exhibited by the areas now operated by drift mines." It is perfectly safe to assume that the seams that are now opened carry at least 50 billion tons of minable and merchantable coal.

The areas of the so-called Upper, Middle, and Lower Measures have been calculated, approximately, by the writer, and the total number of square miles (11,000) corresponds with the estimate made by Doctor White.

	Square miles.	Per cent.
Monongahela series	3,500	31.8
Conemaugh, and Allegheny-Kanawha	5,000	45.5
Pottsville (Pocahontas and New River)	2,500	22.7
Total	11,000	100.0

Taking 1,500 acres as a fair allotment or reservation for each of the 593 commercial mines in the State, as reported by the mine inspectors, we have this showing:

	Acres.	Per cent.
Coal area under development	889,500	12.5
Coal area untouched	6,170,500	87.5
Total	7,060,000	100.0

The coals are uniformly good and cover every known fuel requirement. Forty per cent of the current production represents coals that are almost smokeless and fully equal if not superior to the Welsh coals in heat units. It is probably only a question of a few years until the State will be an active competitor for the markets of southern Europe, South America, etc. Three strong railway systems—the Baltimore and Ohio, Chesapeake and Ohio, and Norfolk and Western—furnish direct lines from the mines to the seaboard, and two new roads—the Deepwater-Tidewater and Wabash—are now under construction.

Fortunately for the State the railway companies and the operators realize the permanency of the industry and every modern appliance for the economical production and movement of the coal is being brought into service. With established markets at home and prospective markets abroad, with almost 600 mines in active operation, and with excellent rail, river, and tide-water shipping facilities, West Virginia will continue to increase the volume of its coal production until it becomes a close rival to Pennsylvania.

West Virginia is the only one of the more important coal-producing States whose output in 1904 exceeded that of 1903. The production in this State increased from 29,337,241 short tons in 1903 to 32,602,819 tons in 1904, a gain of 3,265,578 short tons, or 11.1 per cent. The high level of prices reached in 1903, however, did not continue through 1904, and the value of the product, notwithstanding the larger tonnage, decreased from $34,297,019 to $28,807,420, a loss of $5,489,599, or 16 per cent. The average price per ton declined from $1.17 to 88 cents.

The number of men employed in the coal mines of West Virginia in 1904 was 47,485, who worked an average of 197 days, against 41,554 for 210 days in 1903. As the production in 1904 amounted to 32,602,819 short tons, the average production per man was 686.6 short tons for the year, and 3.49 for each day worked, while in 1903, when the output was 29,337,241 short tons, the daily tonnage per man was 3.36 and the yearly tonnage 706.

Efforts to put the coal mines of West Virginia on an 8-hour basis have not been attended with much success. Out of 464 mines which reported the number of hours per day, and which employed a total of 44,627 men, there were 271 employing 30,751 men that worked 10 hours, and 137 mines, having 11,855 men, that worked 9 hours. Only 53 mines, with 1,870 men, reported 8 hours.

Strikes occurred in 56 mines during 1904, and 3,682 men were idle for an average of 45 days each. In 1903, 1,524 men were on strike for an average of 41 days. The total time lost in 1904 was equal to 1.8 per cent of the time made.

The use of mining machines in West Virginia has grown rapidly in the last five years. In 1899, with 154 machines in operation, the machine-mined product amounted to 1,881,125 short tons. In 1902, 579 machines produced 5,738,045 tons; in 1903, 788 machines were used in the production of 8,193,840 tons, and in 1904, 901 machines produced 9,526,749 short tons.

In the following tables are shown the statistics of production during the last two years, by counties, with the distribution of the product for consumption:

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	1,064
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	1,563,372	1.14	224	1,525
Mineral	517,862	8,042	3,195	....	529,099	766,787	1.45	222	657
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	193
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, Nicholas, and Ritchie.

Coal production of West Virginia in 1904, 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	636,598	5,553	11,862	12,006	666,019	$544,110	$0.82	187	867
Brooke	64,385	3,216	105	....	67,706	72,962	1.08	168	233
Clay	54,400	1,000	414	....	55,814	73,694	1.32	114	179
Fayette	6,417,521	76,152	99,276	629,298	7,222,247	6,416,453	.89	182	11,974
Grant	186,139	2,471	11,202	....	199,812	184,301	.92	225	294
Hancock	66,600	12,178	750	....	79,528	88,180	1.11	239	127
Harrison	2,670,993	14,319	29,501	19	2,714,832	2,293,037	.84	187	2,822
Kanawha	3,027,509	53,140	40,156	13,451	3,134,256	2,940,290	.93	176	5,988
McDowell	4,838,334	48,519	73,640	1,794,645	6,755,138	5,736,361	.85	210	9,676
Marion	3,181,331	19,523	49,654	156,961	3,407,469	2,910,824	.85	203	3,130
Marshall	292,520	100,148	5,926	....	398,594	391,586	.98	238	511
Mason	51,039	63,959	2,439	....	117,437	142,914	1.22	197	270
Mercer	1,541,509	24,807	19,965	330,784	1,917,065	1,689,396	.88	212	2,061
Mineral	564,020	5,213	416	....	569,649	604,358	1.06	203	948
Mingo	1,440,945	15,839	12,926	....	1,469,710	1,258,572	.86	232	2,516
Monongalia	138,071	4,744	5,481	52,271	200,567	168,250	.84	188	267
Nicholas	36,817	1,115	520	....	38,452	38,571	1.00	116	187
Ohio	74,556	44,729	1,560	....	120,845	117,942	.98	208	187
Preston	582,662	11,372	20,054	51,538	665,626	555,299	.84	206	1,222
Putnam	363,174	20,816	2,850	....	386,840	413,788	1.07	202	1,019
Raleigh	579,980	5,873	5,941	....	591,794	498,749	.84	193	1,009
Randolph	251,291	19,496	6,492	102,343	379,622	350,215	.92	200	469
Taylor	262,392	19,113	1,827	....	283,332	217,954	.77	190	349
Tucker	706,118	13,009	21,670	386,086	1,126,883	1,069,127	.95	259	1,114
Other counties[a]	10,326	7,584	....	....	17,910	16,815	.94	132	66
Small mines	....	15,672	....	....	15,672	13,672	....	....	....
Total	28,039,230	609,560	424,627	3,529,402	32,602,819	28,807,420	.88	197	47,485

[a] Braxton, Gilmer, Lincoln, Logan, and Ritchie.

The production during the last five years, by counties, with the increases and decreases in 1904, as compared with 1903, is shown in the following table:

Coal production of West Virginia, by counties, 1900–1904.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase 1904.	Decrease 1904.
Barbour	216,231	313,376	512,725	742,928	666,019	....	76,909
Brooke	60,970	73,198	40,372	35,025	67,706	32,681	....
Clay	....	....	....	22,094	55,814	33,720	....
Fayette	5,742,138	6,052,389	4,775,112	6,092,193	7,222,247	1,130,054	....
Grant	....	....	2,776	78,932	199,812	120,880	....
Hancock	....	....	80,400	153,763	79,528	....	74,235
Harrison	945,955	1,762,563	2,066,597	2,504,638	2,714,832	210,194	....
Kanawha	2,062,741	1,983,903	1,848,617	3,034,912	3,134,256	99,344	....
Lewis	....	....	540	....	....	....	....
McDowell	4,921,235	4,995,511	5,459,655	6,103,800	6,755,138	651,338	....
Marion	3,241,675	3,411,597	3,397,194	3,133,699	3,407,469	273,770	....
Marshall	231,571	217,237	243,791	372,897	398,594	25,697	....
Mason	142,209	129,964	144,727	127,646	117,437	....	10,209
Mercer	1,009,536	964,028	1,248,279	1,375,780	1,917,065	541,285	....
Mineral	641,156	597,776	514,993	529,099	569,649	40,550	....
Mingo	574,156	576,886	806,174	1,164,554	1,469,710	305,156	....
Monongalia	87,400	110,801	153,474	161,912	200,567	38,655	....
Nicholas	....	....	....	21,050	38,452	17,402	....
Ohio	137,796	191,761	230,241	147,232	120,845	....	26,387
Preston	381,947	489,239	590,436	805,060	665,626	....	139,434
Putnam	137,870	242,789	184,259	298,499	386,840	88,341	....
Raleigh	90,507	148,493	281,817	417,459	591,794	174,335	....
Randolph	179,588	161,561	400,145	458,401	379,622	....	78,779
Taylor	523,258	380,590	368,650	292,146	283,332	....	8,814
Tucker	1,180,053	1,097,340	1,166,080	1,241,565	1,126,883	....	114,682
Other counties and small mines	139,215	167,400	53,772	21,957	33,582	11,625	....
Total	22,647,207	24,068,402	24,570,826	29,337,241	32,602,819	[a]3,265,578	....

[a] Net increase.

For commercial purposes 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 are designated, respectively, the Fairmont or Upper Monongahela district, and the Elk Garden or Upper Potomac. Those in the southern portion are the Pocahontas or Flat Top district and the New and Kanawha rivers 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 Railway. The Pocahontas or Flat Top region is tributary to the main branch of the Norfolk and Western Railway. All of the product of this district goes either west or to tide water over that line. The New and Kanawha rivers district is named from the two rivers which drain it, the coal being shipped partly by the Chesapeake and Ohio Railway, which passes through it, and partly by barges on the Kanawha River. The most important district from the productive point of view is that of the New and Kanawha rivers, 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, 1886–1904.

[Short tons.]

Year.	New and Kanawha rivers district.[a]	Pocahontas or Flat Top district.[b]	Fairmont or Upper Monongahela district.[c]	Upper Potomac or Elk Garden district.[d]
1886	2,290,563	968,484	406,976	383,712
1887	2,379,296	1,357,040	520,064	503,343
1888	2,840,630	1,912,695	473,489	518,878
1889	2,669,016	2,290,270	456,582	666,956
1890	3,012,414	2,702,092	600,131	819,062
1891	3,632,209	3,137,012	1,150,569	1,052,308
1892	3,773,021	3,508,260	1,141,430	942,154
1893	4,099,112	3,815,280	1,255,956	1,129,397
1894	3,650,971	5,059,025	1,655,532	927,220
1895	4,399,623	4,044,998	1,550,256	1,125,601
1896	4,650,455	4,608,113	1,743,590	1,245,012
1897	4,921,701	4,859,373	2,074,663	1,425,026
1898	5,947,272	5,521,160	2,525,294	1,531,562
1899	6,544,956	6,033,344	3,374,183	1,786,009
1900	7,804,879	6,901,637	4,187,630	1,999,797
1901	8,427,574	6,736,107	5,174,160	1,856,677
1902	7,089,805	7,431,687	5,463,791	2,581,218
1903	9,843,063	8,319,775	5,638,337	2,229,065
1904	11,429,403	11,013,959	7,937,845	1,896,344

[a] Includes Clay, Fayette, Kanawha, Nicholas, Putnam, and Raleigh counties.
[b] Includes Logan, McDowell, Mercer, and Mingo counties, and Tazewell County, Va.
[c] Includes Barbour, Harrison, Marion, Monongalia, Preston, and Taylor counties.
[d] Includes Grant, Mineral, and Tucker counties.

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-four years there has only been one exception to a steadily increasing output, and that during the period the average annual increase has exceeded 1,200,000 tons.

Annual increase in the coal production of West Virginia, 1881–1904.

[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	1904 over 1903	3,265,578
1891 over 1890	1,826,011	Total increase in 24 years	30,922,819
1892 over 1891	518,090	Average annual increase	1,288,451
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 1863, when the State was formed out of Virginia, has been as follows:

Coal production of West Virginia, 1863–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1863	444,648	1884	3,360,000
1864	454,888	1885	3,369,062
1865	487,897	1886	4,005,796
1866	512,068	1887	4,881,620
1867	589,360	1888	5,498,800
1868	609,227	1889	6,231,880
1869	603,148	1890	7,394,654
1870	608,878	1891	9,220,665
1871	618,830	1892	9,738,755
1872	700,000	1893	10,708,578
1873	1,000,000	1894	11,627,757
1874	1,120,000	1895	11,387,961
1875	1,120,000	1896	12,876,296
1876	896,000	1897	14,248,159
1877	1,120,000	1898	16,700,999
1878	1,120,000	1899	19,252,995
1879	1,400,000	1900	22,647,207
1880 [a]	1,829,844	1901	24,068,402
1881	1,680,000	1902	24,570,826
1882	2,240,000	1903	29,337,241
1883	2,335,833	1904	32,602,819

[a] United States census, fiscal year.

WYOMING.

Total production in 1904, 5,178,556 short tons; spot value, $6,747,909.

Coal-bearing formations underlie a larger proportion of Wyoming than of any other of the Rocky Mountain States. It is the second largest producing State in the Rocky Mountain region, Colorado ranking first, and, if production in Wyoming continues to increase in the next few years as it has done in the last twenty-five, it will soon rival Colorado for first place in the region. Most of the productive area in Wyoming is included within the plains region, while that of Colorado is in or adjacent to the main mountain ranges. More than half of the coal produced in Wyoming is lignitic in character, a large proportion of the lignite output coming from the same fields which extend from North Dakota through southeastern Montana to the northeastern part of Wyoming. The bituminous fields occur largely in the more mountainous regions and are, like the other Rocky Mountain areas, in somewhat limited fields as compared with the lignite beds in the northeastern part of the State. Among the more important producing areas are the Carbon and Hanna fields in Carbon County, which include the operations at Hanna and Carbon, the Rock Springs field in Sweetwater County, the Hams Fork field in Uinta County, and the Almy field, also in Uinta County, the last two counties producing nearly 75 per cent of the State's entire output. The principal lignite production is at Sheridan, in Sheridan County. Most of the lignite is black in color, and having many of the characteristics of bituminous coal is frequently classed as such by the producers. The other fields which have not yet been reached by railroads are the Henrys Fork field in the southern part of Sweetwater County, the Wind River field in Fremont County, the Big Horn Basin in Big Horn County, and the Teton field in the northern part of Uinta County. Another field penetrated by the Union Pacific system is the Rawlings field, extending from the southern part of Fremont County, through northeastern Sweetwater, into Carbon County. The operations here are not of great importance. The Sublette field, in the western part of Uinta County, crossed by the Oregon Short Line, is also of little importance.

The production of 5,178,556 short tons of coal in 1904 was the maximum tonnage recorded in the history of the State. Compared with 1903 it shows an increase of 543,263 short tons, or not quite 12 per cent. The value of the product increased $1,016,628, from $5,731,281 in 1903 to $6,747,909 in 1904, a gain of nearly 18 per cent. The average price per ton advanced from $1.24 to $1.30.

Although there was a decided increase in the number of mining machines reported at work in the mines of Wyoming in 1904, the statistics of production per man employed indicate a decrease in individual efficiency. In 1903 the average tonnage produced per man was 928.4, the best record made for the year in any State except Utah. In 1904 the production per man declined to 914.9 tons. The daily production per man in 1904 was 3.49 tons, against 3.68 tons in 1903. The majority of the mines in Wyoming worked 10-hour days, 17 mines employing 5,087 men reporting that length of working day; 1 mine, employing 491 men, worked 9 hours; 5 mines, employing 19 men, worked 8 hours, and 1 small mine, employing 4 men, worked 11 hours a day.

The reports to the United States Geological Survey for 1904 show that the number of machines used for undercutting coal in Wyoming increased from 59 in 1903 to 72 in 1904, and that the machine-mined production increased from 783,822 tons, or 16.91 per cent of the total, in 1903, to 1,053,702 tons, or 20.35 per cent of the total, in 1904.

There were no labor troubles of any kind reported in the coal mines of Wyoming in 1904.

In the following tables is shown the production of coal in Wyoming during 1903 and 1904, by counties, with the distribution of the product for consumption:

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.

Coal production of Wyoming in 1904, 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.*				
Bighorn	....	6,175	60	....	6,235	$13,148	$2.11	188	17
Converse	68,176	3,080	6,130	....	77,386	154,029	1.99	225	144
Sheridan	529,533	11,320	13,932	....	554,785	674,972	1.22	222	720
Sweetwater	1,916,884	7,882	68,227	....	1,992,993	2,585,592	1.30	279	2,120
Uinta	1,725,632	8,484	65,953	....	1,800,069	2,295,435	1.28	254	1,702
Other counties [a]	663,032	12,275	62,006	6,600	743,913	1,018,333	1.37	278	957
Small mines	....	3,175	....	....	3,175	6,400	....	....	....
Total	4,903,257	52,391	216,308	6,600	5,178,556	6,747,909	1.30	262	5,660

[a] Carbon, Crook, Fremont, Johnson, and Weston.

In the following table is shown the production, by counties, during the last five years, with the increases and decreases in 1904 as compared with 1903:

Coal production of Wyoming, 1900–1904, by counties.

[Short tons.]

County.	1900.	1901.	1902.	1903.	1904.	Increase 1904.	Decrease 1904.
Bighorn	....	....	902	....	6,235	6,235	....
Carbon	530,659	530,626	382,207	243,323	336,292	92,969	....
Converse	49,230	59,190	72,329	91,050	77,386	....	13,664
Sheridan	126,000	221,000	309,066	455,309	554,785	99,476	....
Sweetwater	1,624,036	1,705,880	1,595,340	1,628,944	1,992,993	364,049	....
Uinta	1,146,429	1,439,147	1,595,333	1,782,668	1,800,069	17,401	....
Weston	509,085	507,908	457,801	416,974	398,367	....	18,607
Crook, Fremont, Johnson, Natrona	29,163	21,623	16,513	14,934	9,254	....	5,680
Small mines	....	....	....	2,091	3,175	1,084	....
Total	4,014,602	4,485,374	4,429,491	4,635,293	5,178,556	[a] 543,263	....

[a] Net increase.

Coal mining in Wyoming is said to have begun in 1865, a production of 800 tons being reported as mined by the early settlers in that year. Active development began three years later with the completion of the Union Pacific Railroad, and in 1868 the production amounted to 6,925 short tons. In 1869 the production had increased to 49,382 short tons, the output being used chiefly by the railroad company. The growth of the industry since the first production in 1865 is shown in the following table:

Annual production of coal in Wyoming, 1865–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.
1865	800	1885	807,328
1866	2,500	1886	829,355
1867	5,000	1887	1,170,318
1868	6,925	1888	1,481,540
1869	49,382	1889	1,388,947
1870 [a]	50,000	1890	1,870,366
1871	147,328	1891	2,327,841
1872	221,745	1892	2,503,839
1873	259,700	1893	2,439,311
1874	219,061	1894	2,417,463
1875	300,808	1895	2,246,911
1876	334,550	1896	2,229,624
1877	342,853	1897	2,597,886
1878	333,200	1898	2,863,812
1879	400,991	1899	3,837,392
1880 [a]	589,595	1900	4,014,602
1881	420,000	1901	4,485,374
1882	707,764	1902	4,429,491
1883	779,689	1903	4,635,293
1884	902,620	1904	5,178,556

[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 combustion 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. 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.

Since 1893, however, when the first plant of 12 by-product coke ovens was completed by the Semet-Solvay Company at Syracuse, N. Y., there has been a steady and noteworthy increase in the construction of retort or by-product recovery ovens in the United States. The coke product of these ovens 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. The use of coke for domestic purposes, particularly in the summer months, and in cities having smoke-preventing ordinances, is constantly increasing. It is impossible to make any separation of the coke, either retort or beehive, sold for such 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 report. It is no longer possible to limit the discussion of coke making in this chapter to that used for blast furnace and foundry purposes. Only gas-house coke is excluded.

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, Minnesota, New York, New Jersey, and Wisconsin. The ovens in Minnesota were completed and put in blast in 1904. The plant consists of 50 Otto-Hoffman ovens located at Duluth. The ovens near Baltimore, Md., and at Del Ray and Wyandotte, Mich., are supplied with coal from other States. One of the two plants in Wisconsin is composed of beehive ovens, in which coal from Pennsylvania is used. With this exception all of the coking establishments outside of the coking-coal producing States are retort-oven plants.

The writer again desires to make special acknowldgement 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.

Including the production of coke from by-product retort ovens, which in 1904 amounted to 2,608,229 short tons, the total output of the coke ovens of the United States last year was 23,621,520 short tons, against 25,274,281 short tons in 1903. The decrease in 1904 as compared with the preceding year was 1,652,761 short tons, or 6.54 per cent. The total value of the product declined in much greater proportion from $66,498,664 in 1903 to $46,026,183, a decrease of $20,472,481, or 31 per cent. The decline in production was a natural one, due to a slump in the iron trade during the summer months and which was in turn caused for the most part by the unsettled conditions which usually attend a Presidential campaign. And while these conditions also affected prices, the great difference between the values of the production in 1904 and 1903 was due to the abnormally high prices which prevailed in the early part of 1903, when, because of the fuel famine induced by the anthracite strike of the preceding year, manufacturers of coke were able to obtain almost any figure they might demand. The average price for all the coke made and sold in 1904 was only 9 cents less than that in 1901, and was higher than that of any year from 1893 to 1899, inclusive.

In 1903 the value of the coal used in the manufacture of coke was $42,447,449, while the value of the coke produced from it was $66,498,664, making a difference of $24,051,215 as representing the profits on the coking operations, less the cost of producing and selling. In 1904 the value of the coal used was $37,133,832, and the value of the coke produced was $46,026,183, a difference of $8,892,351.

The year 1904 opened up with every prospect for a good year's business. The last two months of the preceding year had witnessed a notable falling off in demand and thousands of ovens had been put out of blast, but early in January conditions exhibited a decided improvement, and, while prices did not show any material advance, idle ovens were fired and production steadily increased, the principal exception to an otherwise satisfactory trade being complaints of insufficient car supply. These conditions continued until May, when, following a boom in demand and production the preceding month, the supply caught up with the demand and prices began to sag. By June the slump in the iron trade, which had begun in May, was decidedly in evidence, and Connellsville coke, which had been quoted at from $1.60 to $1.75 per short ton, dropped to as low as $1.40. June, July, and August were marked by exceptional dullness throughout the coking regions, but by the first of September conditions began to improve, and from then until the end of the year the trade was in excellent shape. Prices began to advance in October, and in December Connellsville furnace coke, which had sold for $1.40 in June and July, was quoted as high as $2.45. Many operators consider that the year 1904 was disappointing and unsatisfactory, but, considering the fact that it was a Presidential election year, there seems to be comparatively little cause for complaint. Furthermore, at the time of writing this report, the indications are that the current year will make the record for coke production with prices considerably above the average, though they may not and should not reach the high levels of 1902 and 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, and continued to do so during 1904.

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 79,334, a gain of 10,265. On December 31, 1904, the number of ovens had increased to 83,499, a gain of 4,165 over 1903. The number of ovens idle in 1903 was 1,999 leaving a total of 77,335, which produced 25,274,281 tons of coke, or an average of 326.8 tons per oven. In 1904, out of 83,499 ovens, 6,478 were idle, leaving 77,021 which produced 23,621,520 tons of coke or 306.7 tons per oven.

The total number of 77,021 active ovens in 1904 included 2,910 by-product ovens (an increase from 1,956 in 1903) which produced 2,608,229 tons of coke (compared with 1,882,394 tons in 1903). From this it is seen that the average production of the by-product ovens in 1904 was 896 tons each. Deducting the by-product ovens, and the production of by-product coke from the total active ovens and total production in 1904 it appears that there were 74,111 beehive ovens which produced 21,013,291 tons of coke, or 283.5 tons per oven. In 1903 the 1,956 retort ovens produced 1,882,394 tons, an average of 962.4 tons per oven, while 75,379 beehive ovens yielded 23,391,887 tons, or an average of 310.3 tons each. The smaller average production by the by-product ovens in 1904 is due to the large number of new ovens put in blast during that year, but which were not in operation the early part of the year. A plant of Semet-Solvay ovens at Milwaukee, Wis., for instance, was fired up May 1, and an Otto-Hoffman plant at Duluth, Minn., was not put in blast until August.

There were under construction at the close of 1904 4,430 new ovens of which 832, or 18.8 per cent were of the retort or by-product type.

The number of completed retort ovens has increased from 1,165 in 1901 to 1,663 in 1902, to 1,956 in 1903 and to 2,910 in 1904. The output from retort ovens has increased from 1,179,900 tons in 1901 to 1,403,588 tons in 1902 to 1,882,394 tons in 1903, and to 2,608,229 tons in 1904. 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; in 1904 by-product coke made up 11 per cent of the total output.

Counting each bank of ovens as a separate establishment, the returns for 1904 show a total of 506 establishments, as compared with 500 in 1903. Eighty-two establishments were idle throughout 1904 as compared with 41 idle plants in 1903. There were also 10 new establishments, having a total of 1,265 ovens, which were not completed and put in blast at the close of 1904.

The details of the production of coke in 1903 and 1904 are presented, by States and Territories, in the following tables:

Manufacture of coke in the United States, by States and Territories, in 1903.

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	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	3,089,783	2.93
Georgia	2	500	0	146,086	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	305,327	2.65
Minnesota	1	0	50	....	....	....	....	....
Missouri	2	8	0	3,004	61.2	1,839	5,797	3.15
Montana	4	555	0	82,118	54.9	45,107	310,882	6.89
New Mexico	2	126	0	18,613	59.4	11,050	31,539	2.85
Ohio	8	440	66	211,473	68	143,913	528,142	3.67
Pennsylvania	212	40,239	1,785	23,724,207	65.9	15,650,932	38,969,101	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] 79,334	[d] 6,175	39,423,525	64.1	25,274,281	66,498,664	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.

Manufacture of coke in the United States, by States and Territories, in 1904.

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	42	9,059	440	3,996,578	58.6	2,340,219	$5,716,413	$2.443
Colorado[a]	15	3,419	0	1,376,354	57.3	789,060	2,590,251	3.28
Georgia	2	500	0	132,270	57.3	75,812	212,697	2.806
Illinois	5	155	120	8,131	54.6	4,439	9,933	2.24
Indiana	1	36	0	0	0	0	0	0
Indian Territory	5	286	0	98,847	45.3	44,808	209,165	4.67
Kansas	6	90	0	14,525	65	9,460	23,485	2.48
Kentucky	7	499	0	140,139	45.7	64,112	138,226	2.15
Missouri	2	8	0	3,815	64	2,446	6,115	2.50
Montana	4	520	0	78,303	53	41,497	280,745	6.77
Ohio	8	539	14	165,487	66	109,284	337,606	3.09
Pennsylvania	217	42,165	1,621	22,432,064	66.2	14,861,064	25,027,462	1.684
Tennessee	17	2,436	190	718,181	52.8	379,240	905,540	2.388
Utah[b]	2	504	0	....	....	....	....	....
Virginia	16	4,345	68	1,636,905	67.3	1,101,716	1,772,717	1.609
Washington	6	256	0	76,993	59	45,432	207,357	4.56
West Virginia	137	16,929	1,319	3,543,338	64.4	2,283,086	3,757,850	1.646
Maryland	1	200	0					
Massachusetts	1	400	0					
Michigan	2	135	0					
Minnesota	1	50	0					
New Jersey	1	100	0	2,046,340	71.8	1,469,845	4,830,621	3.286
New Mexico	2	131	0					
New York	3	352	658					
Wisconsin	2	308	0					
Wyoming	1	71	0					
Total	506	[c]83,499	[d]4,430	36,468,270	64.8	23,621,520	46,026,183	1.948

[a] Includes the production of Utah.
[b] Included with Colorado.
[c] Includes 895 Semet-Solvay, 1,795 Otto-Hoffman and Schniewind, 56 Newton-Chambers, 66 Wilcox, and 98 Rothberg ovens.
[d] Includes 160 Semet-Solvay, 658 Otto-Hoffman, and 14 Wilcox ovens.

Of the 26 States and Territories in which coke was produced in 1904, there were only 3, whose production is reported separately, that exhibited an increase of output as compared with 1903. The combined production of Indiana, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Wisconsin, and Wyoming, 95 per cent of which was from by-product retort ovens, showed an increase of 521,670 short tons, while the total increases in the other 3 States amounted to less than 10,000 short tons. The 13 States, reported separately, whose production in 1904 was less than in 1903, sustained a total loss of 2,184,174 short tons, the net decrease in 1904 amounting to 1,652,761 short tons, or 6.54 per cent. The production of by-product coke increased from 1,882,394 short tons in 1903 to 2,608,229 tons, a gain of 725,835 tons, or 38.6 per cent. The production of beehive coke decreased from 23,391,887 short tons in 1903 to 21,013,291 tons in 1904, a loss of 2,378,596 tons, or a little over 10 per cent.

The most notable decreases in production were among the 3 most important producing States. Pennsylvania's production decreased 789,868 tons, West Virginia's 424,732 tons, and Alabama's 353,278 tons. Colorado, fifth in rank in production, was fourth in the amount of decrease in 1904, with a loss of 264,780 tons, followed by Tennessee, with a decrease of 167,635 tons. All other decreases were less than 100,000 tons.

The increases and decreases in the several States during 1904, as compared with 1903, are shown in the following table:

Increases and decreases in coke production, by States, in 1904, as compared with 1903.

[Short tons.]

State or Territory.	Total quantity.		Increase		Decrease.	
	1903.	1904.	Quantity.	Per cent.	Quantity.	Per cent.
Alabama	2,693,497	2,340,219	....	....	353,278	13.11
Colorado[a]	1,053,840	789,060	....	....	264,780	25.12
Georgia	85,546	75,812	....	....	9,734	11.38
Illinois	2,926	4,439	1,513	51.7	....	....
Indian Territory	49,818	44,808	....	....	5,010	10.06
Kansas	14,194	9,460	....	....	4,734	33.35
Kentucky	115,362	64,112	....	....	51,250	44.42
Missouri	1,839	2,446	607	33.0	....	....
Montana	45,107	41,497	....	....	3,610	8.00
New Mexico	11,050	18,673	7,623	69.0	....	....
Ohio	143,913	109,284	....	....	34,629	24.06
Pennsylvania	15,650,932	14,861,064	....	....	789,868	5.05
Tennessee	546,875	379,240	....	....	167,635	30.65
Virginia	1,176,439	1,101,716	....	....	74,723	6.35
Washington	45,623	45,432	....	....	191	.004
West Virginia	2,707,818	2,283,086	....	....	424,732	15.68
Indiana						
Maryland						
Massachusetts						
Michigan						
Minnesota	929,502	1,451,172	521,670	56.12	....	....
New Jersey						
New York						
Wisconsin						
Wyoming						
Total	25,274,281	23,621,520	....	....	1,652,761	6.54

[a] Includes Utah.

PRODUCTION IN PREVIOUS YEARS.

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. The average production in 1903 and 1904 was 24,447,900 short tons, an increase of 18 per cent over the average for the five years from 1898 to 1902, inclusive.

In the following table are consolidated the statistics of the manufacture of coke in the United States from 1880 to 1904, inclusive:

Statistics of the manufacture of coke in the United States, 1880–1904.

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	79,334	6,175	39,423,525	25,274,281	66,498,664	2.63	64.1
1904	506	83,499	4,430	36,468,270	23,621,520	46,026,183	1.948	64.8

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-five years covered by these reports there have been seven 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 due to a natural reaction from the abnormal production of the preceding year, aided by the unsettled conditions of a Presidential year, and a slump in the iron trade which occurred during the summer months.

Quantity of coke produced in the United States, 1899–1904, by States and Territories.

[Short tons.]

State or Territory.	1899.	1900.	1901.	1902.	1903.	1904.
Alabama	1,787,809	2,110,837	2,148,911	2,552,246	2,693,497	2,340,219
Colorado [a]	530,424	618,755	671,303	1,003,393	1,053,840	789,060
Georgia	50,907	73,928	54,550	82,064	85,546	75,812
Indian Territory	24,339	38,141	37,374	49,441	49,818	44,808
Kansas	14,476	5,948	7,138	20,902	14,194	9,460
Kentucky	81,095	95,532	100,285	126,879	115,362	64,112
Missouri	2,860	2,087	4,749	5,780	1,839	2,446
Montana	56,376	54,731	57,004	53,463	45,107	41,497
New Mexico	44,134	44,774	41,643	23,296	11,050	18,673
Ohio	83,878	72,116	108,774	146,099	143,913	109,284
Pennsylvania	[b] 13,577,870	13,357,295	14,355,917	16,497,910	15,650,932	14,861,064
Tennessee	435,308	475,432	404,017	560,006	546,875	379,240
Utah	(a)	(a)	(a)	(a)	(a)	(a)
Virginia	618,707	685,156	907,130	1,124,572	1,176,439	1,101,716
Washington	30,372	33,387	49,197	40,305	45,623	45,432
West Virginia	2,278,577	2,358,499	2,283,700	2,516,505	2,707,818	2,283,086
Illinois, Indiana	2,370					
Maryland	....					
Massachusetts	(c)					
Michigan	....	506,730	564,191	598,869	932,428	1,455,611
New Jersey	....					
New York	(c)					
Wisconsin	33,437					
Wyoming	15,630					
Total	19,668,569	20,533,348	21,795,883	25,401,730	25,274,281	23,621,520

[a] Colorado includes Utah.
[b] Includes production of New York and Massachusetts.
[c] Included with Pennsylvania.

The annual production since 1880 has been as follows:

Quantity of coke produced in the United States, 1880–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880	3,338,300	1889	10,258,022	1897	13,288,984
1881	4,113,760	1890	11,508,021	1898	16,047,209
1882	4,793,321	1891	10,352,688	1899	19,668,569
1883	5,464,721	1892	12,010,829	1900	20,533,348
1884	4,873,805	1893	9,477,580	1901	21,795,883
1885	5,106,696	1894	9,203,632	1902	25,401,730
1886	6,845,369	1885	13,333,714	1903	25,274,281
1887	7,611,705	1896	11,788,773	1904	23,621,520
1888	8,540,030				

NUMBER OF COKE WORKS IN THE 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	1891, December 31	243
1860 (census year)	21	1892, December 31	261
1870 (census year)	25	1893, December 31	258
1880 (census year)	149	1894, December 31	260
1880, December 31	186	1895, December 31	265
1881, December 31	197	1896, December 31	341
1882, December 31	215	1897, December 31	336
1883, December 31	231	1898, December 31	341
1884, December 31	250	1899, December 31	343
1885, December 31	233	1900, December 31	396
1886, December 31	222	1901, December 31	423
1887, December 31	270	1902, December 31	456
1888, December 31	261	1903, December 31	500
1889, December 31	253	1904, December 31	506
1890, December 31	253		

The 506 establishments which were in existence on December 31, 1904, included 10 with a total of 1,265 ovens, which were not entirely completed before the close of the year and did not contribute to the production in 1904. There were also 82 establishments, having a total of 6,478 ovens, whose ovens were not operated at all during the entire year. These idle plants were for the most part comparatively small, averaging 79 ovens to the establishment. The average number of ovens to each establishment in blast in 1904, was 182.

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 1904—that is to say, 82 old ones that were idle and 10 new ones which had not begun operations—the total number of active plants last year was 424, a little over two and one-quarter 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 1904, considering each bank of ovens as a separate establishment, the average productive capacity for each active plant was 55,711 tons, or 3.1 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 four years from 1900 to 1904 was more than the increase in the eleven years from 1889 to 1900. The 83,499 ovens completed at the end of 1903 include 2,910 by-product recovery ovens.

Number of coke ovens in each State at the close of each year, 1899–1904.

State or Territory.	1899.	1900.	1901.	1902.	1903.	1904.
Alabama	5,599	6,529	7,136	7,571	8,764	9,059
Colorado	1,243	1,488	2,060	3,010	3,455	3,419
Georgia	350	480	510	492	500	500
Illinois	130	154	154	149	155	155
Indiana	52	54	54	50	36	36
Indian Territory	130	230	230	280	286	286
Kansas	95	91	98	97	91	90
Kentucky	300	458	461	485	499	499
Maryland	....	....	....	....	200	200
Massachusetts	400	400	400	400	400	400
Michigan	....	....	30	75	75	135
Minnesota	....	....	....	....	....	50
Missouri	12	10	9	8	8	8
Montana	303	342	328	410	555	520
New Jersey	....	....	....	100	100	100
New Mexico	126	126	126	126	126	134
New York	25	30	30	30	40	352
Ohio	385	369	419	449	440	539
Pennsylvania	27,591	32,548	34,906	36,609	40,239	42,165

Number of coke ovens in each State at the close of each year, 1899–1904—Continued.

State or Territory.	1899.	1900.	1901.	1902.	1903.	1904.
Tennessee	2,040	2,107	2,135	2,269	2,439	2,436
Utah	104	204	204	404	504	504
Virginia	1,588	2,331	2,775	2,974	4,251	4,345
Washington	90	90	148	231	256	256
West Virginia	8,846	10,249	11,544	12,656	15,613	16,929
Wisconsin	120	120	120	120	228	308
Wyoming	74	74	74	74	74	74
Total	49,603	58,484	63,951	69,069	79,334	83,499

Number of coke ovens in the United States on December 31 of each year, 1880–1904.

Year.	Ovens.	Year.	Ovens.	Year.	Ovens.
1880	12,372	1889	34,165	1897	47,668
1881	14,119	1890	37,158	1898	48,383
1882	16,356	1891	40,057	1899	49,603
1883	18,304	1892	42,002	1900	58,484
1884	19,557	1893	44,201	1901	63,951
1885	20,116	1894	44,772	1902	69,069
1886	22,597	1895	45,565	1903	79,334
1887	26,001	1896	46,944	1904	83,499
1888	30,059				

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, 1880–1904.

Year.	Ovens.	Year.	Ovens.	Year.	Ovens.
1880	1,159	1889	2,115	1897	575
1881	1,005	1890	1,375	1898	1,048
1882	712	1891	911	1899	4,037
1883	407	1892	1,893	1900	5,804
1884	812	1893	717	1901	5,205
1885	432	1894	591	1902	8,758
1886	4,154	1895	638	1903	6,175
1887	3,594	1896	383	1904	4,430
1888	2,587				

VALUE OF COKE PRODUCED.

In the following tables are presented statements showing the value of the coke produced in each State during the last six years, and the total value of the coke product of the United States each year since

1880. The effects on the coke trade of the fuel famine caused by the strike in the anthracite region of Pennsylvania are shown by the greatly increased value of the coke product in 1902 and 1903. The amount of coke produced in the United States in 1903 exceeded that of 1901, two years before, by 3,478,398 short tons, or 16 per cent, while the value showed a gain of $22,052,741, or nearly 50 per cent. The return to more normal conditions in 1904 is exhibited by a decrease of 1,652,761 tons, or 6.54 per cent, in the quantity of coke produced, and a decline of $20,472,481 in the value. The average price obtained for the coke sold in 1904 was the lowest in the last five years, but was higher than for the seven years preceding 1900.

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, 1899–1904, by States and Territories.

State or Territory.	1899.	1900.	1901.	1902.	1903.	1904.
Alabama	$3,634,471	$5,629,423	$6,062,616	$8,300,838	$7,622,528	$5,716,413
Colorado	[a]1,333,769	[a]1,746,732	[a]1,626,279	[a]2,754,341	[a]3,089,783	2,590,251
Georgia	116,917	210,646	154,625	298,963	368,351	212,697
Indian Territory	71,965	152,204	154,834	202,921	227,542	209,165
Kansas	30,817	14,985	15,079	54,702	50,221	23,485
Kentucky	161,454	235,505	208,015	317,875	305,327	138,226
Missouri	5,520	5,268	9,968	14,450	5,797	6,115
Montana	356,190	337,079	337,381	360,927	310,882	280,745
New Mexico	99,217	130,251	118,368	74,051	31,539	(b)
Ohio	255,129	194,042	299,430	492,793	528,142	337,606
Pennsylvania	[c]22,881,910	29,692,258	27,066,361	38,451,722	38,969,101	25,027,462
Tennessee	850,686	1,269,555	952,782	1,597,041	1,706,722	905,540
Utah	(d)	(d)	(d)	(d)	(d)	(d)
Virginia	1,071,284	1,464,556	1,483,670	2,322,228	2,724,047	1,772,717
Washington	151,216	160,165	239,028	199,195	214,776	207,357
West Virginia	3,480,408	4,746,633	4,110,011	5,833,226	7,115,842	3,757,850
Illinois, Indiana	5,565					
Maryland	....					
Massachusetts	(e)					
Michigan	....	1,454,029	1,607,476	2,063,894	3,228,064	4,840,554
New Jersey	....					
New York	(e)					
Wisconsin	125,389					
Wyoming	38,510					
Total	34,670,417	47,443,331	44,445,923	63,339,167	66,498,664	46,026,183

[a] Includes value of Utah coke.
[b] Included with miscellaneous establishments.
[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, 1880–1904.

Year.	Value.	Year.	Value.	Year.	Value.
1880	$6,631,265	1889	$16,630,301	1897	$22,102,514
1881	7,725,175	1890	23,215,302	1898	25,586,699
1882	8,462,167	1891	20,393,216	1899	34,670,417
1883	8,121,607	1892	23,536,141	1900	47,443,331
1884	7,242,878	1893	16,523,714	1901	44,445,923
1885	7,629,118	1894	12,328,856	1902	63,339,167
1886	11,153,366	1895	19,234,319	1903	66,498,664
1887	15,321,116	1896	21,660,729	1904	46,026,183
1888	12,445,963				

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. Last year opened with coke in good demand and with prices fairly satisfactory. The slump in the iron trade, however, which occurred during the summer of 1904, resulted in an overproduction of coke with the natural result that prices declined sharply, and, although the market recovered and business took on a "boom" character in the later months of the year, the average prices for all coke sold during the year was the lowest since 1899.

Average value per short ton, at the ovens, of the coke made in the United States, 1899–1904, by States and Territories.

State or Territory.	1899.	1900.	1901.	1902.	1903.	1904.
Alabama	$2.03	$2.667	$2.82	$3.25	$2.83	$2.443
Colorado[a]	2.51	2.82	2.42	2.74	2.93	3.28
Georgia	2.30	2.849	2.83	3.643	4.306	2.806
Indian Territory	2.96	3.99	4.14	4.10	4.57	4.67
Kansas	2.13	2.52	2.11	2.617	3.54	2.48
Kentucky	1.99	2.465	2.07	2.505	2.65	2.15
Missouri	1.93	2.52	2.099	2.50	3.15	2.50
Montana	6.32	6.159	5.918	6.75	6.89	6.77
New Mexico	2.25	2.909	2.84	3.178	2.85	(b)
Ohio	3.04	2.69	2.75	3.37	3.67	3.09
Pennsylvania	[c]1.69	2.22	1.885	2.33	2.49	1.684
Tennessee	1.95	2.67	2.358	2.85	3.12	2.388
Utah	(d)	(d)	(d)	(d)	(d)	(d)
Virginia	1.73	2.137	1.635	2.065	2.315	1.609
Washington	4.98	4.797	4.858	4.94	4.71	4.56
West Virginia	1.53	2.01	1.80	2.318	2.628	1.646
Illinois } Indiana }	2.35					
Maryland	....					
Massachusetts	(e)					
Michigan	....	2.87	2.849	3.446	3.46	3.28
New Jersey	....					
New York	(e)					
Wisconsin	3.75					
Wyoming	2.46					
Average	1.76	2.31	2.039	2.49	2.63	1.948

[a] Includes Utah.
[b] Included with miscellaneous.
[c] Average value, including New York and Massachusetts.
[d] Included with Colorado.
[e] Included with Pennsylvania.

Average value per short ton, at the ovens, of the coke made in the United States, 1880–1904.

Year.	Value.	Year.	Value.	Year.	Value.
1880	$1.99	1889	$1.62	1897	$1.663
1881	1.88	1890	2.02	1898	1.594
1882	1.77	1891	1.97	1899	1.76
1883	1.49	1892	1.96	1900	2.31
1884	1.49	1893	1.74	1901	2.039
1885	1.49	1894	1.34	1902	2.49
1886	1.63	1895	1.44	1903	2.63
1887	2.01	1896	1.837	1904	1.948
1888	1.46				

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 1904. 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 and lost it again in 1904.

Rank of the States and Territories in production of coke, 1880–1904.

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

State or Territory.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Pennsylvania	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Alabama	2	2	2	3	2	3	3	3	3	3	3	2	3	2
West Virginia	3	3	3	2	3	2	2	2	2	2	2	3	2	3
Virginia	6	6	6	6	6	6	5	4	4	4	4	4	4	4
Colorado	5	4	4	4	5	4	6	5	5	5	5	5	5	5
Massachusetts	......	......	......	......	......	......	......	......	7	7	6	7	7	6
Tennessee	4	5	5	5	4	5	4	6	6	6	7	6	6	7
Maryland	......	......	......	......	......	......	......	......	......	......	......	......	8	8
Utah	14	13	11	12	11	14	15	13	16	15	12	10	9	9
Michigan	......	......	......	......	......	......	......	......	......	......	20	14	11	10
New York	......	......	13	11	12	16	12	14	15	16	16	16	16	11
Wisconsin	9	11	12	18	17	17	16	10	13	12	13	12	15	12
New Jersey	......	......	......	......	......	......	......	......	......	......	......	......	13	13
Ohio	8	8	10	8	8	7	7	7	8	10	8	8	10	14
Georgia	7	7	7	7	7	9	9	9	11	9	11	11	14	15
Kentucky	10	9	8	9	9	10	10	15	9	8	9	9	12	16
Washington	16	15	16	16	13	11	13	12	14	17	14	17	18	17
Indian Territory	13	16	15	19	16	13	11	11	17	14	17	15	17	18
Montana	11	10	9	10	10	8	8	8	10	11	10	13	19	19
Minnesota	......	......	......	......	......	......	......	......	......	......	......	......	......	20
New Mexico	20	......	18	15	14	12	21	17	12	13	15	18	21	21
Kansas	12	12	14	13	15	18	17	18	19	19	19	19	20	22
Illinois	17	18	21	21	20	20	20	19	22	22	22	22	23	23
Wyoming	19	......	20	17	18	15	14	16	18	18	18	20	22	24
Missouri	15	14	17	20	21	21	19	21	20	20	21	21	24	25
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 1899 to 1904, and the total quantity used each year since 1880, are shown in the tables which follow.

Quantity of coal used in the manufacture of coke in the United States, 1899–1904, by States and Territories.

[Short tons.]

State or Territory.	1899.	1900.	1901.	1902.	1903.	1904.
Alabama	3,028,472	3,582,547	3,849,908	4,237,491	4,483,942	3,996,578
Colorado	[a] 898,207	[a] 997,861	[a] 1,148,901	[a] 1,695,188	[a] 1,776,974	[a] 1,376,354
Georgia	78,098	140,988	89,919	129,642	146,086	132,270
Indian Territory	59,255	79,534	74,746	110,934	110,088	98,847
Kansas	26,988	10,303	11,629	35,827	30,503	14,525
Kentucky	151,503	190,268	204,297	265,121	247,950	140,139
Missouri	5,320	3,775	9,041	10,430	3,004	3,815
Montana	110,274	108,710	102,950	99,628	82,118	78,303
New Mexico	68,594	74,261	72,350	40,943	18,613	([b])
Ohio	142,678	115,269	162,624	219,401	211,473	165,487
Pennsylvania	[c] 19,930,419	20,239,966	21,736,467	25,017,326	23,724,207	22,432,064
Tennessee	779,995	854,789	739,246	1,025,864	1,001,356	718,181
Utah	([d])	([d])	([d])	([d])	([d])	([d])
Virginia	994,635	1,083,827	1,400,231	1,716,110	1,860,225	1,636,905
Washington	50,813	54,310	78,393	68,546	73,119	76,993
West Virginia	3,802,825	3,868,840	3,734,076	4,078,579	4,347,160	3,543,338
Illinois } Indiana	4,217					
Maryland	....					
Massachusetts	([e])					
Michigan	....	708,295	793,187	852,977	1,306,707	2,054,471
Minnesota	....					
New Jersey	....					
New York	([e])					
Wisconsin	54,950					
Wyoming	32,100					
Total	30,219,343	32,113,543	34,207,965	39,604,007	39,423,525	36,468,270

[a] Includes coal coked in Utah.
[b] Included with miscellaneous.
[c] Includes Massachusetts and New York.
[d] Included with Colorado.
[e] Included with Pennsylvania.

Quantity of coal used annually in the manufacture of coke in the United States, 1880–1904.

[Short tons.]

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1880	5,237,741	1889	15,960,973	1897	20,907,319
1881	6,546,762	1890	18,005,209	1898	25,249,570
1882	7,577,646	1891	16,344,540	1899	30,219,343
1883	8,516,670	1892	18,813,337	1900	32,113,543
1884	7,951,974	1893	14,917,146	1901	34,207,965
1885	8,071,126	1894	14,348,750	1902	39,604,007
1886	10,688,972	1895	20,848,323	1903	39,423,525
1887	11,859,752	1896	18,694,422	1904	36,468,270
1888	12,945,350				

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 1903 and 1904, 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 1904 was 36,468,270 short tons as compared with 39,423,525 short tons in 1903. The value of the coal consumed in 1904 was $37,133,838 against $42,447,449 in 1903, showing that the quantity of coal used in 1904 was 2,955,255 tons less than in 1903, and the value decreased $5,313,611. In 1903 the difference between the value of the coal and that of the coke made from it was $24,051,215; in 1904 this difference amounted to $8,892,345.

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	2.144
Kansas	30,503	39,717	1.30	2.15	2.795
Kentucky	247,950	165,423	.667	2.15	1.434
Missouri	3,004	3,553	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	23,724,207	24,377,048	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	39,423,525	42,447,449	1.077	1.56	1.68

[a] Includes Utah.

Quantity and value of coal used in the manufacture of coke in the United States in 1904 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	3,996,578	$4,249,971	$1.06	1.708	$1.81
Colorado [a]	1,376,354	1,392,156	1.01	1.744	1.76
Georgia	132,270	136,803	1.03	1.745	1.797
Illinois	8,131	3,480	.43	1.832	.788
Indian Territory	98,847	113,591	1.15	2.206	2.537
Kansas	14,525	16,600	1.14	1.536	1.75
Kentucky	140,139	66,980	.478	2.186	1.045
Missouri	3,815	4,055	1.06	1.56	1.654
Montana	78,303	245,041	3.13	1.887	5.906
Ohio	165,487	285,535	1.725	1.515	2.613
Pennsylvania	22,432,064	21,459,256	.956	1.51	1.444
Tennessee	718,181	648,972	.90	1.894	1.705
Virginia	1,636,905	1,119,110	.684	1.485	1.016
Washington	76,993	221,986	2.88	1.695	4.882
West Virginia	3,543,338	2,788,785	.787	1.55	1.22
Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New Mexico, New York, Wisconsin, Wyoming	2,046,340	4,381,517	2.14	1.39	2.975
Total	36,468,270	37,133,838	1.018	1.544	1.572

[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	1893	1.57	3,140
1881	1.59	3,180	1894	1.56	3,120
1882	1.58	3,160	1895	1.56	3,120
1883	1.56	3,120	1896	1.58½	3,170
1884	1.63	3,260	1897	1.57	3,140
1885	1.58	3,160	1898	1.57	3,140
1886	1.56	3,120	1899	1.54	3,080
1887	1.56	3,120	1900	1.57	3,140
1888	1.51	3,020	1901	1.57	3,140
1889	1.55	3,100	1902	1.56	3,120
1890	1.56	3,120	1903	1.56	3,120
1891	1.58	3,160	1904	1.544	3,088
1892	1.57	3,140			

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 and Territory during the last six years:

Percentage yield of coal in coke, 1899–1904, by States and Territories.

State or Territory.	1899.	1900.	1901.	1902.	1903.	1904.
Alabama	59	58.9	55.8	60.2	60	58.6
Colorado [a]	59	62	58.4	59.2	59.3	57.3
Georgia	65.2	52.4	60.7	63.3	58.5	57.3
Indian Territory	41	48	50	44.6	45	45.3
Kansas	53.6	57.7	61.4	58.3	46.5	65
Kentucky	53.5	50.2	49	47.8	46.5	45.7
Missouri	53.8	55.3	52.5	55.4	61.2	64
Montana	51	50.3	55.4	53.7	54.9	53
New Mexico	64.3	60.3	57.5	56.9	59.4	60
Ohio	58.8	62.5	66.9	66.6	68	66
Pennsylvania	[b] 68.1	66	66	65.9	65.9	66.2
Tennessee	55.8	55.6	54.6	54.6	54.6	52.8
Virginia	62.2	63.2	64.7	65.5	63.2	67.3
Washington	59.8	61.5	62.7	58.8	62.4	59
West Virginia	60	60.9	61.1	61.7	62.3	64.4
Illinois }	56.2					
Indiana }						
Maryland	....					
Massachusetts	....					
Michigan	....	71.5	71.1	70.2	71.3	71.9
New Jersey	....					
New York	....					
Wisconsin	60.8					
Wyoming	48.7					
Total average	65.1	63.9	63.7	64.1	64.1	64.8

[a] Average, including Utah. [b] Average, including New York and Massachusetts.

Percentage yield of coal in coke, 1880–1904.

Year.	Percentage yield of coal.	Year.	Percentage yield of coal.	Year.	Percentage yield of coal.
1880	63	1889	64	1897	63.5
1881	63	1890	64	1898	63.6
1882	63	1891	63	1899	65.1
1883	64	1892	64	1900	63.9
1884	61	1893	63.5	1901	63.7
1885	63	1894	64	1902	64.1
1886	64	1895	64	1903	64.1
1887	64.2	1896	63	1904	64.8
1888	66				

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 1904, 10,318,267 short tons or 28 per cent of the total quantity of coal used in coke making was slack, and of this slack coal 53 per cent was washed before being coked. Of the run-of-mine coal used in coke making less than 10 per cent (2,370,118 tons out of a total of 26,150,003 tons in 1904) was washed before coking.

Among the more important coke-producing States it is to be observed that in Pennsylvania only about 10 per cent of the coal used is slack, and that less than 4 per cent of the run-of-mine coal used is washed; in West Virginia two-thirds of the coal charged into the ovens is slack, and of this only about 7 per cent is washed; in Alabama, 60 per cent of the coal used is slack, nearly all of which is washed; in Virginia a small amount of coal was washed in 1904, though as a usual thing the coal is used unwashed; in Colorado slack coal only is used for the most part, and most of this is washed.

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		2,522,046	4,483,942
Colorado [a]			594,584	1,182,390	1,776,974
Georgia	39,750			106,336	146,086
Indian Territory	331		1,295	108,462	110,088
Kansas		3,701	10,708	16,094	30,503
Kentucky	50	55,062	88,060	104,778	247,950
Missouri			3,004		3,004
Montana	1,891	80,227			82,118
New Mexico			855	17,758	18,613
Ohio	174,544		9,216	27,713	211,473
Pennsylvania	20,297,033	644,441	1,981,544	801,189	23,724,207
Tennessee	157,717	404,949	74,560	364,130	1,001,356
Virginia	857,332		1,002,893		1,860,225
Washington		73,119			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		81,968	560,893	1,306,707
Total	24,701,705	1,866,945	6,738,997	6,115,878	39,423,525

[a] Includes Utah.

Character of coal used in the manufacture of coke in 1904.

[Short tons.]

State or Territory.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
Alabama	670,271	922,864	741	2,402,702	3,996,578
Colorado [a]	400		745,450	630,504	1,376,354
Georgia		42,741		89,529	132,270
Illinois				8,131	8,131
Indian Territory			59,760	39,087	98,847
Kansas			6,900	7,625	14,525
Kentucky		39,315	10,787	90,037	140,139
Missouri			3,815		3,815
Montana		78,303			78,303
Ohio	140,915		7,249	17,323	165,487
Pennsylvania	19,447,395	697,771	1,340,474	946,424	22,432,064
Tennessee	1,471	302,943	60,784	352,983	718,181

[a] Includes Utah.

Character of coal used in the manufacture of coke in 1904—Continued.

State or Territory.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
Virginia	1,213,226	44,222	379,457		1,636,905
Washington		76,993			76,993
West Virginia	1,247,935	1,350	2,128,251	165,802	3,543,338
Maryland					
Massachusetts					
Michigan					
Minnesota					
New Jersey	1,058,272	163,616	96,620	727,832	2,046,340
New Mexico					
New York					
Wisconsin					
Wyoming					
Total	23,779,885	2,370,118	4,840,288	5,477,979	36,468,270

In the following table the statistics regarding the character of the coal for the years 1890 to 1904, inclusive, are consolidated:

Character of coal used in the manufacture of coke in the United States, 1890–1904.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	14,060,907	338,563	2,674,492	931,247	18,005,209
1891	12,255,415	290,807	2,945,359	852,959	16,344,540
1892	14,453,638	324,050	3,256,493	779,156	18,813,337
1893	10,306,082	350,112	3,049,075	1,211,877	14,917,146
1894	9,648,750	405,266	3,102,652	1,192,082	14,348,750
1895	15,609,875	237,468	3,052,246	1,948,734	20,848,323
1896	11,307,905	763,244	4,685,832	1,937,441	18,694,422
1897	13,234,985	1,037,830	4,180,575	2,453,929	20,907,319
1898	16,758,244	1,672,972	4,487,949	2,330,405	25,249,570
1899	20,870,915	1,457,961	4,976,737	2,913,730	30,219,343
1900	21,062,090	1,369,698	5,677,006	4,004,749	32,113,543
1901	23,751,468	1,600,714	4,546,201	4,309,582	34,207,965
1902	26,347,698	1,647,818	5,781,088	5,827,403	39,604,007
1903	24,701,705	1,866,945	6,738,997	6,115,878	39,423,525
1904	23,779,885	2,370,118	4,840,288	5,477,979	36,468,270

The increasing proportion of washed coal used for coke making, as shown in the preceding table, is quite striking. In 1894, 11 per cent of the total amount of coal used was washed; in 1899 the percentage of washed coal to the total was 14.5; in 1902 it was nearly 20, and in 1904 it was 21.5.

COKE MAKING IN BY-PRODUCT OVENS.

The statistics relating to the manufacture of coke in by-product ovens show that the total number of this type of ovens completed and in blast increased from 1,663 in 1902 to 1,956 in 1903 and 2,910 in 1904, and that the production of by-product coke increased from 1,882,394 short tons in 1903 to 2,608,229 short tons in 1904, a gain of 725,835 tons, or 38.6 per cent, although the total production of coke for the year exhibited a decrease of 1,652,761 tons. There were under construction at the close of 1904 832 new by-product ovens.

The average yearly production of the 2,910 by-product ovens in operation during 1904 was 896 short tons of coke. In 1903 the average production per oven was 962.4 tons and in 1902 it was 844 tons. The average yearly production of the beehive ovens in 1904 was 283.5 tons against 310.3 tons in 1903.

In order to produce the 2,608,229 tons of coke in 1904 there were used in the by-product ovens 3,572,949 short tons of coal, showing a yield in coke of 73 per cent, a much larger yield than can be obtained from 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 1904 was 64.8 per cent, and this is probably higher than the results actually obtained.

The by-product coking industry in the United States has not yet reached its "teens." The first plant established in this country was erected at Syracuse, N. Y., in 1893 and consisted of 12 Semet-Solvay ovens. In that year the production of by-product coke amounted to 12,850 short tons. At the close of 1904 there were 2,910 ovens in operation with 832 in course of construction. Of the 832 ovens building at the close of the year, 40 were at Tuscaloosa, Ala., 120 were building at South Chicago, Ill., 658 at Buffalo, N. Y., and 14 at Cleveland, Ohio. When these ovens are completed, making a total of 3,742 by-product ovens, their production, at an average of 1,000 tons per oven per year, will be equivalent to nearly 16 per cent of the total coke production of the United States in 1904. In 1902 5.5 per cent of the total output was made in by-product ovens. In 1903 the proportion of by-product coke had increased to 7.4 per cent and in 1904 it was a little over 11 per cent.

The merging of the interests controlling the Semet-Solvay and Otto-Hoffman ovens, which was effected in 1903, proved of short duration and was dissolved in 1904. Both companies, however, continue to make the American Coal Products Company of New York their selling agency for the disposal of the tar and ammonia produced at all of their different plants.

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, 1893–1904.

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	1,956	1,335	1,882,394
1904	[a] 2,910	[b] 832	2,608,229

[a] Includes 865 Semet-Solvay, 1,825 Otto-Hoffman, 98 Rothberg, 66 Wilcox, and 56 Newton-Chambers.
[b] Includes 160 Semet-Solvay, 658 Otto-Hoffman, and 14 Wilcox.

In the following table is shown the record of by-product coke ovens, by States, at the close of 1900, 1901, 1902, 1903, and 1904:

Record of by-product ovens, by States.

State.	Ovens December 31, 1900.		Ovens December 31, 1901.		Ovens December 31, 1902.		Ovens December 31, 1903.		Ovens December 31, 1904.	
	Completed.	Building.	Completed.	Building.	Completed.	Building.	Completed.	Building.	Completed.	Building.
Alabama	120	120	120	120	240	40	240	40	240	40
Illinois	0	0	0	0	0	0	0	120	0	120
Maryland	0	0	0	200	0	200	200	0	200	0
Massachusetts	400	0	400	0	400	0	400	0	400	0
Michigan	0	30	30	45	75	60	75	60	135	0
Minnesota	0	0	0	0	0	0	0	50	50	0
New Jersey	0	100	0	100	100	0	100	0	100	0
New York	30	564	30	564	30	574	40	500	352	658
Ohio	0	50	50	0	50	60	50	66	116	14
Pennsylvania	355	232	355	504	592	412	675	419	1,061	0
Virginia	60	0	60	0	56	0	56	0	56	0
West Virginia	120	0	120	0	120	0	120	0	120	0
Wisconsin	0	0	0	0	0	0	0	80	80	0
Total	1,085	1,096	1,165	1,533	1,663	1,346	1,956	1,335	2,910	832

In the following table will be found a statement of the kind of by-product ovens completed and building in the United States at the close of 1904, and the States in which they are located:

Kind and location of by-product coke ovens built and building in the United States at the close of 1904.

State.	Semet-Solvay.		Otto-Hoffman and Schniewind.		Wilcox.		Rothberg.		Newton Chambers.	
	Built.	Building.	Built.	Building.	Built.	Building.	Built.	Building.	Built.	Building.
Alabama	240	40								
Illinois		120								
Maryland			200							
Massachusetts			400							
Michigan	120		15							
Minnesota			50							
New Jersey			100							
New York	70		188	658			94			
Ohio			50		66	14				
Pennsylvania	265		792				4			
Virginia									56	
West Virginia	120									
Wisconsin	80									
Total	895	160	1,795	658	66	14	98		56	

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 1904, 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, 1869–1904.

Year ending June 30—	Quantity.	Value.	Year ending December 31—	Quantity.	Value.
	Short tons.			*Short tons.*	
1869		$2,053	1887	39,561	$100,312
1870		6,388	1888	39,427	107,914
1871		19,528	1889	28,609	88,008
1872	9,575	9,217	1890	20,724	101,767
1873	1,091	1,366	1891	50,736	223,184
1874	634	4,588	1892	27,420	86,350
1875	1,046	9,648	1893	37,125	99,683
1876	2,065	8,657	1894	32,567	70,359
1877	4,068	16,686	1895	29,622	71,366
1878	6,616	24,186	1896	48,577	114,713
1879	6,035	24,748	1897	39,131	98,077
1880	5,047	18,406	1898	46,127	142,334
1881	15,210	64,987	1899	42,398	142,504
1882	14,924	53,244	1900	115,557	371,341
1883	20,634	113,114	1901	81,456	266,075
1884	14,483	36,278	1902	140,489	423,775
1885	20,876	64,814	1903	142,776	437,625
1886	28,124	84,801	1904	180,855	648,521

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	193,798	546,066	1902	439,590	1,785,188
1898	223,509	600,931	1903	466,351	2,091,875
1899	313,819	858,856	1904	585,872	2,286,401

PRODUCTION OF COKE BY STATES.

ALABAMA.

For two decades Alabama and West Virginia have been close rivals for the second place among the coke producing States. Since 1885 each of these States has held the place ten times, and during the last four years have alternated each year. In 1904 the honor fell to Alabama, although the production in the State for 1904 was less than that of either of the two years immediately preceding. The reason that Alabama regained the position it held in 1902 is that in a year of generally decreased production West Virginia, which held it in 1903 by a narrow margin, was a heavier loser.

The coke production of Alabama in 1904 was 2,340,219 short tons, as compared with 2,693,497 short tons in 1903, a decrease of 353,278 short tons, or 13.11 per cent. The value declined in considerably greater proportion from $7,622,528 to $5,716,413, a loss of $1,906,115, or 25 per cent. The average price per ton declined from $2.83 in 1903 to $2.44 in 1904. In 1903 the average value per ton of the coal charged into the ovens was $1.185, while in 1904 it was $1.06. The average value of the coal per ton of coke made in 1903 was $1.967, while in 1904 it was $1.81. From this it may be seen that while the value of the coke produced in 1904 was 39 cents less than it was in 1903, only 15.7 cents of this was represented, or made up, by the reduction in the value of the coal used.

The statistics as collected by the United States Geological Survey for 1904 show that there were 42 coke-making establishments in the State, with a total of 9,059 ovens built, and 440 in course of construction at the end of the year, against 39 establishments in 1903 with 8,764 ovens built and 381 building. The 42 establishments in 1904 include nine having a total of 1,810 completed ovens that were not in operation during the year, and two whose ovens (140 in all) were not completed before the end of the year. The active ovens, of which there were 7,249, produced an average of 323 tons of coke each. These included 240 Semet-Solvay by-product ovens, each of which produced an average of 1,449 tons. The 440 ovens building included 40 Semet-Solvay ovens in course of construction at Tuscaloosa.

The coking-coal fields of Alabama have been divided into three districts, known by the names of the rivers which drain them—the Warrior, the Coosa, and the Cababa. No coke was produced in the Coosa district in 1904, and only 1 establishment in the Cahaba district was in operation. The statistics are therefore not given by districts.

The statistics of coke production in Alabama since 1880 are as follows:

Statistics of the manufacture of coke in Alabama, 1880–1904.

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	413,184	244,009	609,185	2.50	60
1885	11	1,075	16	507,934	301,180	755,645	2.50	59
1886	14	1,301	1,012	635,120	375,054	993,302	2.65	59
1887	15	1,555	1,362	550,047	325,020	775,090	2.39	59
1888	18	2,475	406	848,608	508,511	1,189,579	2.34	60
1889	19	3,944	427	1,746,277	1,030,510	2,372,417	2.30	59
1890	20	4,805	371	1,809,964	1,072,942	2,589,447	2.41	59
1891	21	5,068	50	2,144,277	1,282,496	2,986,242	2.33	60
1892	20	5,320	90	2,585,966	1,501,571	3,464,623	2.31	58
1893	23	5,548	60	2,015,[illegible]	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 6,329	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	8,300,858	3.25	60.2
1903	39	c 8,764	d 381	4,483,942	2,693,497	7,622,528	2.83	60
1904	42	c 9,059	d 440	3,996,578	2,340,219	5,716,413	2.443	58.6

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, 1890–1904.

[Short tons.]

Year.	Run of mines.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	1,480,669	0	206,106	123,189	1,809,964
1891	1,943,469	0	192,238	8,570	2,144,277
1892	2,463,366	0	11,100	111,500	2,585,966
1893	1,246,307	51,163	292,198	425,730	2,015,398
1894	411,097	7,429	477,820	677,899	1,574,245
1895	1,208,020	0	32,068	1,219,377	2,459,465
1896	1,292,191	70,125	51,674	1,159,723	2,573,713
1897	902,310	120,420	91,200	1,337,545	2,451,475
1898	1,290,794	828,294	25,000	670,527	2,814,615
1899	1,656,226	725,238	9,898	637,110	3,028,472
1900	1,729,882	152,077	165,418	1,535,170	3,582,547
1901	1,641,830	491,298	17,796	1,698,984	3,849,908
1902	1,233,117	509,376	290	2,494,708	4,237,491
1903	1,359,450	602,446	....	2,522,046	4,483,942
1904	670,271	922,864	741	2,402,702	3,996,578

The rapid development of the use of washed coal for coke making in Alabama, as shown in the preceding table, is of special interest. It will be observed that while the total amount of coal used in 1904 was 487,364 short tons less than in 1903, the amount of washed coal used shows an increase of 201,074 tons.

COLORADO AND UTAH.

The statistics of the manufacture of coke in these two States is combined in order not to divulge information regarding individual operations, there being but two establishments in Utah, both of which are owned by one company. The combined production of the two States in 1904 was 789,060 short tons, which, compared with that of 1903, when it was 1,053,840 short tons, shows a decrease of 264,780 short tons, or a little over 25 per cent. The decreased production was due for the most part to labor troubles, which affected not only the coal mines and coke ovens, but the smelting industry, particularly in Colorado, and which for bitterness and exhibitions of lawlessness have seldom if ever been equaled.

Stimulated probably by the smaller output, the average price for coke in 1904 showed an advance of 35 cents per ton, so that the total value, while less than that of the preceding year by nearly $500,000, was a decrease of only about 16 per cent, as compared with the decrease of 25 per cent in product.

There were 17 establishments, with 3,923 ovens, in the two States in 1904, a gain of 1 in the number of plants and a decrease of 36 in the number of ovens. Only one small establishment of 20 ovens was idle throughout the entire year. All of the ovens in both States are of the beehive type, and the average production per active oven in 1903 was 202 tons of coke.

Practically all of the coal used in the manufacture of coke in Colorado and Utah is the slack produced in the mining operations. Most of it is washed before being charged into the ovens.

The statistics of the manufacture of coke in Colorado since 1880 and in Colorado and Utah since 1892 are shown in the following table:

Statistics of the manufacture of coke in Colorado and Utah, 1880–1904.

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	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	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]	16	3,455	0	1,776,974	1,053,840	3,089,783	2.93	59.3
1904[a]	15	3,419	0	1,376,354	789,060	2,590,251	3.28	57.3

[a] Includes production and value of coke in Utah and of coal coked.

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, 1890–1904.

[Short tons.]

Year.	Run of mine.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
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
1904	400	0	745,450	630,504	1,376,354

GEORGIA.

Dade County, in the extreme northwestern corner of Georgia, contains a small area of the Walden Ridge, Tennessee, coal fields, and a portion of the adjoining county of Walker is underlain by an extension of the Lookout Mountain beds of Alabama. Extensive mining operations are carried on in both counties, and a good grade of coke is made from the slack produced in mining. The iron furnaces in and near Chattanooga, Tenn., supply the principal market for the coke.

As in Alabama, the production of coke in Georgia for 1904 shows a decrease from that of 1903, the output of the ovens declining from 85,546 short tons to 75,812 tons, the falling off being due to the slackened demand in the iron trade in 1904. This was more clearly shown in the decrease in value, which declined from $368,351 to $212,697, a loss of $155,654, or over 40 per cent. The number of establishments and the number of ovens were the same in both years.

The statistics of coke production in Georgia since 1880 have been as follows:

Statistics of the manufacture of coke in Georgia, 1880–1904.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	1	140	40	63,402	38,041	$81,789	$2.15	60
1881	1	180	40	68,960	41,376	88,753	2.15	60
1882	1	220	44	77,670	46,602	100,194	2.15	60
1883	1	264	36	111,687	67,012	147,166	2.20	60
1884	1	300	0	132,113	79,268	169,192	2.13	60
1885	2	300	0	117,781	70,669	144,198	2.04	60
1886	2	300	0	136,133	82,680	179,031	2.17	60
1887	2	300	0	158,482	79,241	174,410	2.20	50
1888	1	290	0	140,000	83,721	177,907	2.12	60
1889	1	300	0	157,878	94,727	149,059	1.57	60
1890	1	300	0	170,388	102,233	150,995	1.48	60
1891	1	300	0	164,875	103,057	231,878	2.25	62.5
1892	1	300	0	158,978	81,807	163,614	2.00	51.5
1893	1	338	0	171,645	90,726	136,089	1.50	52.8
1894	1	338	0	166,523	93,029	116,286	1.25	55.9
1895	1	330	0	118,900	60,212	70,580	1.17	50.6
1896	1	334	0	109,655	53,673	68,486	1.276	49
1897	1	300	0	67,000	33,000	42,240	1.28	49.3
1898	2	350	0	81,108	49,529	77,230	1.56	61
1899	2	350	100	78,098	50,907	116,917	2.30	65.2
1900	2	480	0	140,988	73,928	210,646	2.849	52.4
1901	2	510	0	89,919	54,550	154,625	2.83	60.7
1902	2	492	38	129,642	82,064	298,963	3.643	63.3
1903	2	500	0	146,086	85,546	368,351	4.306	58.5
1904	2	500	0	132,270	75,812	212,697	2.806	57.3

As shown in the following table, nearly all of the coal used in the manufacture of coke in Georgia since 1890 was washed before being charged into the ovens.

Character of coal used in the manufacture of coke in Georgia, 1890–1904.

[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
1904	0	42,741	0	89,529	132,270

INDIAN TERRITORY.

Five coke-making establishments, with a total of 286 ovens, contributed to the production in 1904, as in 1903. The output decreased 10.06 per cent, from 49,818 short tons in 1903 to 44,808 tons in 1904. The value of the product decreased from $227,542 to $209,165.

All of the ovens in the Indian Territory have been constructed for the purpose of utilizing the slack coal produced in mining and for which there is little or no demand. Most of it is washed before coking. The ovens are all of the standard beehive type.

The statistics of the manufacture of coke in the Indian Territory from 1880 to 1904 are as follows:

Statistics of the manufacture of coke in the Indian Territory, 1880–1904.

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	110,088	49,818	227,542	4.57	45
1904	5	286	0	98,847	44,808	209,165	4.67	45.3

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, 1890–1904.

[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	110,088
1904	0	0	59,760	39,087	98,847

KANSAS.

The coking industry in Kansas is of small importance and depends for its existence upon a limited demand of the zinc smelters, which do not require a high grade of coke. In fact, all of the coke made in the State at present is at ovens operated in connection with the zinc works. The production in 1904 amounted to 9,460 short tons, valued at $23,485 against 14,194 tons, valued at $50,221, in 1903, and 20,902 tons, valued at $54,702, in 1902. The coal used is Pittsburg (Kansas) slack, about one-half of which is washed before coking. Of the six establishments, with a total of 90 ovens, in the State in 1904, two, having 55 ovens, were idle throughout the year.

The statistics of the manufacture of coke in Kansas from 1880 to 1904 are as follows:

Statistics of the manufacture of coke in Kansas, 1880–1904.

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	0	4,800	3,070	$6,000	$1.95	64
1881	3	15	0	8,800	5,670	10,200	1.80	64.4
1882	3	20	0	9,200	6,080	11,460	1.70	66
1883	4	23	0	13,400	8,430	16,560	1.96	62.9
1884	4	23	0	11,500	7,190	14,580	2.02	62.5
1885	4	23	0	15,000	8,050	13,255	1.65	53.7
1886	4	36	0	23,062	12,493	19,204	1.54	54.2
1887	4	39	0	27,604	14,950	28,575	1.91	54
1888	6	58	0	24,934	14,831	29,073	1.96	59.5
1889	6	68	0	21,600	13,910	26,593	1.91	64
1890	7	68	0	21,809	12,311	29,116	2.37	56
1891	6	72	0	27,181	14,174	33,296	2.35	52
1892	6	75	0	15,437	9,132	19,906	2.18	59.2

Statistics of the manufacture of coke in Kansas, 1880-1904—Continued.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1893	6	75	0	13,645	8,565	$18,640	$2.18	62.8
1894	6	61	0	13,288	8,439	15,660	1.855	63.5
1895	5	55	0	8,424	5,287	11,289	2.14	62.8
1896	6	55	0	8,940	4,785	8,676	1.813	53.5
1897	4	57	0	11,772	6,181	9,272	1.50	52.5
1898	6	47	50	7,856	4,180	6,455	1.545	53
1899	9	95	0	26,988	14,476	30,817	2.13	53.6
1900	9	91	0	10,303	5,948	14,985	2.52	57.7
1901	12	98	3	11,629	7,138	15,079	2.11	61.4
1902	10	97	12	35,827	20,902	54,702	2.617	58.3
1903	9	91	0	30,503	14,194	50,221	3.54	46.5
1904	6	90	0	14,525	9,460	23,485	2.48	65

KENTUCKY.

Kentucky is the only one of the United States whose coal supplies are drawn from any two of the great fields. The eastern counties of the State are underlain by the Coal Measures of the Appalachian system, while the southern extremity of the central or Illinois-Indiana field is worked extensively in the western part of Kentucky. Coke is made from coal mined in both the eastern and western parts of the State, and although the coals of the eastern counties are in large part included among the coking coals of the Appalachian field, and while little or no coke is made from the coals of the central field in Illinois or Indiana, more than half of Kentucky's coke output is made in the western part of the State.

The production in 1904 amounted to 64,112 short tons, valued at $138,226, as compared with 115,362 short tons, valued at $305,327, in 1903. Of the 7 establishments in the State, 2 made no coke in 1904. One establishment at Ashland uses washed run-of-mine coal. All of the others use slack, 90 per cent of which is washed.

The statistics of the manufacture of coke in Kentucky from 1880 to 1904 are as follows:

Statistics of the manufacture of coke in Kentucky, 1880-1904.

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	45	0	7,206	4,250	$12,250	$2.88	59
1881	5	45	0	7,406	4,370	12,630	2.89	59
1882	5	45	0	6,906	4,070	11,530	2.83	59
1883	5	45	0	8,437	5,025	14,425	2.87	60
1884	5	45	0	3,451	2,223	8,760	3.94	64
1885	5	33	0	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	0	29,129	14,565	31,730	2.18	50

Statistics of the manufacture of coke in Kentucky, 1880–1904—Continued.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1888	10	132	2	42,642	23,150	$47,244	$2.04	54
1889	9	166	100	25,192	13,021	29,769	2.28	52
1890	9	175	103	24,372	12,343	22,191	1.80	51
1891	7	115	24	64,390	33,777	68,281	2.02	52
1892	5	287	100	70,783	36,123	72,563	2.01	51
1893	4	283	100	97,212	48,619	97,350	2.00	50
1894	6	293	0	66,418	29,748	51,566	1.73	44.8
1895	5	293	0	63,419	25,460	37,249	1.46	40.1
1896	4	264	0	55,719	27,107	42,062	1.55	48.6
1897	5	268	0	64,234	32,117	45,454	1.41	50
1898	5	292	2	44,484	22,242	32,213	1.448	50
1899	6	300	130	151,503	81,095	161,454	1.99	53.5
1900	5	458	3	190,268	95,532	235,505	2.465	50.2
1901	5	461	0	204,297	100,285	208,015	2.07	49
1902	7	485	12	265,121	126,879	317,875	2.505	47.8
1903	7	499	0	247,950	115,362	305,327	2.65	46.5
1904	7	499	0	140,139	64,112	138,226	2.15	45.7

MISSOURI.

The manufacture of coke in Missouri is confined to two small plants, the product of which, like that of the ovens in Kansas, is used at zinc works in connection with which the ovens are operated. All of the coal used in coke making is unwashed slack.

The statistics of the production of coke in Missouri from 1887, when coking began in this State, to 1904 are as follows:

Statistics of the manufacture of coke in Missouri, 1887–1904.

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	4	0	5,400	2,970	$10,395	$3.50	55
1888	1	4	0	5,000	2,600	9,100	3.50	52
1889	3	9	0	8,485	5,275	5,800	1.10	62
1890	3	10	0	9,491	6,136	9,240	1.51	65
1891	3	10	0	10,377	6,872	10,000	1.45	66
1892	3	10	0	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
1904	2	8	0	3,815	2,446	6,115	2.50	64

MONTANA.

The total production of coke in Montana in 1904 amounted to 41,497 short tons, as compared with 45,107 tons in 1903. There are only four establishments in the State, and one of these, having 100 ovens completed, did not produce any coke last year. Thirty-five ovens were abandoned in 1904, reducing the total number in the State from 555 to 520. The 420 ovens in blast during 1904 produced a little less than 100 tons each. All of the coal used for coke making was run of mine, and all of it was washed before coking.

The statistics of the manufacture of coke in Montana from 1883, when ovens were first reported, to 1904 are as follows:

Statistics of the manufacture of coke in Montana, 1883–1904.

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	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	0	82,118	45,107	310,882	6.89	54.9
1904	4	520	0	78,303	41,497	280,745	6.77	53

NEW MEXICO.

There are only two coke-making plants in New Mexico, and only one of these made coke in 1904, the coal used being washed slack.

The statistics of the production of coke in New Mexico from 1882, when coke ovens were first reported, until 1904 are as follows:

Statistics of the manufacture of coke in New Mexico, 1882–1904.

Year.	Establishment.	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.*
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	118,368	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
1904	2	134	0	(a)	18,673	(a)	(a)	(a)

[a] Included with miscellaneous States having but one or two establishments.

OHIO.

Although Ohio ranks fourth in importance among the coal-producing States, it has never attained any prominence as a coke producer. This is in part due to the fact that much of the coal in the State makes an excellent furnace fuel in its raw state, and also doubtless to the proximity of the higher grades of coking coals of Pennsylvania and West Virginia.

The sixty-six Wilcox by-product ovens reported as under construction in 1903 were completed and put in blast in the latter part of 1904. Fourteen additional ovens of the same type were building at the close of the year.

Of the eight establishments in the State, two, having a total of 170 ovens, were idle throughout the year. The most of the coal used is unwashed run of mine.

In the table which follows the statistics of the production of coke in Ohio for the years 1880 to 1904 are consolidated.

Statistics of the manufacture of coke in Ohio, 1880–1904.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	15	616	25	172,453	100,596	$255,905	$2.54	58
1881	15	641	0	201,045	119,469	297,728	2.49	59
1882	16	647	0	181,577	103,722	266,113	2.57	57
1883	18	682	0	152,502	87,834	225,660	2.57	58
1884	19	732	0	108,164	62,709	156,294	2.49	58
1885	13	642	0	68,796	39,416	109,723	2.78	57
1886	15	560	0	59,332	34,932	94,042	2.69	59
1887	15	585	223	164,974	93,004	245,981	2.65	56
1888	15	547	12	124,201	67,194	166,330	2.48	54
1889	13	462	0	132,828	75,124	188,222	2.50	56
1890	13	443	1	126,921	74,633	218,090	2.92	59
1891	9	421	0	69,320	38,718	76,901	1.99	56
1892	10	436	0	95,236	51,818	112,907	2.18	54.4
1893	9	435	0	42,963	22,436	43,671	1.95	52
1894	8	363	0	55,324	32,640	90,875	2.78	59
1895	8	377	0	51,921	29,050	69,655	2.40	56
1896	9	431	0	128,923	80,868	208,789	2.58	62.7
1897	9	433	0	151,545	95,087	235,784	2.48	62.7
1898	10	441	0	134,757	85,535	211,558	2.47	63.5
1899	8	385	0	142,678	83,878	255,129	3.04	58.8
1900	8	369	50	115,269	72,116	194,042	2.69	62.5
1901	8	419	0	162,624	108,774	299,430	2.75	66.9
1902	9	449	*a* 60	219,401	146,099	492,793	3.37	66.6
1903	8	440	*a* 66	211,473	143,913	528,142	3.67	68
1904	8	*b* 539	*a* 14	165,487	109,284	337,606	3.09	66

a Wilcox ovens. *b* Includes 50 Otto-Hoffman and 66 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.		Slack.		Total.
	Unwashed.	Washed.	Unwashed.	Washed.	
1890	34,729	0	54,473	37,719	126,921
1891	5,200	0	64,120	0	69,320
1892	35,334	0	32,402	27,500	95,236
1893	0	0	24,859	18,104	42,963
1894	0	0	14,845	40,479	55,324
1895	28,053	0	10,868	13,000	51,921
1896	88,616	0	24,325	15,982	128,923
1897	92,192	0	29,353	30,000	151,545
1898	92,963	0	19,794	22,000	134,757
1899	88,771	0	23,907	30,000	142,678
1900	68,175	0	17,094	30,000	115,269
1901	100,345	0	42,279	20,000	162,624
1902	161,783	0	19,618	38,000	219,401
1903	174,544	0	9,216	27,713	211,473
1904	140,915	0	7,249	17,323	165,487

PENNSYLVANIA.

Pennsylvania stands preeminently at the head of the coal-producing States, having contributed during the last twenty-five years more than 50 per cent of the total coal product of the entire country. In the manufacture of coke Pennsylvania holds relatively a still more prominent position, with over 60 per cent of the total production. Of the coke production in the State about 60 per cent is made in what is known as the famous Connellsville region of Fayette and Westmoreland counties. 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 is found to produce 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 1904 amounted to 14,861,064 short tons out of a total for the United States of 23,621,520 short tons. In 1903 Pennsylvania produced 15,650,932 short tons out of a total of 25,274,281 short tons. Out of these totals the Connellsville district proper is credited with a production of 9,102,391 tons in 1903, and of 8,883,220 tons in 1904. Adding to the Connellsville production the output of the Upper and Lower Connellsville districts the entire region produced in 1903 12,215,821 short tons and in 1904 12,161,216 tons.

Compared with 1903, the coke production of Pennsylvania in 1904 shows a decrease of 789,868 short tons, or 5.05 per cent. The decrease in production is small when considered with the decline in the production of pig iron during the year, and which was due in large degree to the unsettled conditions of business which usually mark the years of Presidential campaigns. The decreased production in 1904 was felt in every district of the State with the exception of the Lower Connellsville, whose output increased over half a million tons. In proportion to their total output the heaviest sufferers were the Irwin district and the Clearfield-Center-Elk district. The production in the Irwin district declined from 133,290 tons in 1903 to less than 10,000 tons in 1904, and that of the Clearfield-Center-Elk from 178,276 tons to 35,931 tons. The Upper Connellsville production fell off over 50 per cent from 784,132 short tons in 1903 to 390,540 tons in 1904. The production in the Connellsville district decreased about 220,000 tons.

The banner year of coke production in Pennsylvania was 1902, when the total output for the State amounted to 16,497,910 short tons, compared with which the production in 1904 shows a decrease of 1,636,846 short tons, or nearly 10 per cent. The unsatisfactory conditions affecting the coking industry of Pennsylvania in 1904 are evinced more strikingly by the decline in values than by the falling off in production, for while the amount of coke produced shows a decrease of only 789,868 short tons, or a little over 5 per cent, the total value decreased from $38,969,101 in 1903 to $25,027,462 in 1904, a loss of $13,941,639, or 35.8 per cent. The average price per ton showed a decline from $2.49 to $1.68.

A rather striking difference is exhibited between the decrease in the value of the coke product in 1904 as compared with 1903, and in the decrease of value of the coal from which the coke was made. In 1903, 23,724,207 short tons of coal were used, the coal being valued at $24,377,048; while in 1904, 22,432,064 short tons of coal, worth $21,459,256, were consumed in coke making—that is to say, the coal used in 1904 was worth $2,917,792 less than that used in 1903 (the quantity having decreased 1,292,143 short tons), while the coke value shows a loss of nearly $14,000,000, with a decrease in product of less than 800,000 tons. The difference between the value of the coal made into coke in Pennsylvania in 1904 and the value of the coke made from it was $3,568,206, or 16.6 per cent. In 1903, the difference between the values of the coal and coke was $14,592,053, or nearly 60 per cent.

The number of coke-making establishments in Pennsylvania increased from 212 in 1903 to 217 in 1904, a gain of 5. The total number of completed ovens increased from 40,239 to 42,165, a gain of 1,926. There were building at the close of 1904, 1,621 new ovens against 1,785 ovens in course of construction at the close of the preceding year. The completed ovens at the end of 1904 included 792 Otto-Hoffman, 265 Semet-Solvay, and 4 Rothberg ovens. There were no by-product ovens reported as in course of construction during the year. Of the total number of establishments in the State there were 24 having a total of 2,014 ovens which did not produce any coke during the year.

In the following table are given the statistics of the production of coke in Pennsylvania for the years 1880 to 1904, inclusive:

Statistics of the manufacture of coke in Pennsylvania, 1880–1904.

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	40,239	1,785	23,724,207	15,650,932	38,969,101	2.49	65.9
1904	217	42,165	1,621	22,432,064	14,861,064	25,027,462	1.684	66.2

[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	303,591	630,195	323,732	13,046,143
1891	9,470,646	256,807	558,106	302,985	10,588,544
1892	11,237,253	159,698	1,059,994	134,400	12,591,345
1893	8,302,307	216,762	739,128	128,505	9,386,702
1894	8,671,534	118,279	204,811	64,494	9,059,118
1895	13,618,376	34,728	440,869	117,594	14,211,567
1896 [a]	9,289,089	273,082	1,463,047	99,392	11,124,610
1897 [a]	11,540,459	301,052	1,441,611	255,524	13,538,646
1898 [a]	14,083,073	350,153	1,472,347	402,268	16,307,841
1899 [b]	16,854,706	366,206	1,824,784	884,723	19,930,419
1900	17,692,623	647,045	1,300,796	599,502	20,239,966
1901	19,689,162	647,209	893,476	506,620	21,736,467
1902	21,615,568	602,287	1,623,624	1,175,847	25,017,326
1903	20,297,033	644,441	1,981,544	801,189	23,724,207
1904	19,447,395	697,771	1,340,474	946,424	22,432,064

[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. A few ovens constructed recently in Elk County have been included in the Clearfield-Center district. 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 southwest of the Connellsville basin proper, from which it is separated by the Greensburg anticline. It embraces the recent developments in the vicinity of Uniontown and is now the second producing district of the State. 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.

The statistics of the manufacture of coke in Pennsylvania, by districts, in 1903 and 1904 are presented in the following tables:

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	a 2,047	b 100	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	9	850	0	278,329	178,276	583,906	3.275	64
Connellsville	99	e 22,563	f 130	13,498,859	9,102,391	20,707,442	2.27	67.4
Greensburg	7	1,332	0	813,216	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	g 237	h 130	....	....	....	....	....
Lower Connellsville	32	5,753	786	3,452,568	2,329,298	5,522,884	2.37	67.5
Pittsburg i	7	j 1,585	k 359	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	19	2,556	280	1,180,947	784,132	2,133,513	2.72	66.4
Total	212	40,239	1,785	23,724,207	15,650,932	38,969,101	2.49	65.9

a Includes 160 Otto-Hoffman ovens.
b 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 173 Otto-Hoffman and 25 Semet-Solvay ovens.
k Includes 159 Otto-Hoffman ovens.

Coke production in Pennsylvania in 1904, 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	17	a 2,153	100	785,105	551,570	$1,152,101	$2.09	70.3
Allegheny Valley b	2	53	0	....	....	....	....	....
Broadtop c	5	606	0	358,807	237,639	645,045	2.71	66.2
Clearfield-Center-Elk	9	828	0	61,564	35,931	79,746	2.22	58.4
Connellsville	101	d 22,695	1,044	13,185,690	8,883,220	13,990,329	1.575	67.4
Greensburg	7	1,332	0	511,303	314,954	551,228	1.75	61.6
Irwin	6	691	0	14,468	8,793	14,576	1.66	60.8
Lebanon and Schuylkill	3	e 334	0	....	....	....	....	....
Lower Connellsville	34	6,570	250	4,229,755	2,887,456	4,623,133	1.60	68.2
Pittsburg f	6	g 2,142	0	1,370,629	841,459	1,795,257	2.13	61.4
Reynoldsville-Walston	8	2,101	200	1,313,507	709,502	1,585,950	2.235	54
Upper Connellsville	19	2,660	27	601,236	390,540	590,097	1.51	64.9
Total	217	42,165	1,621	22,432,064	14,861,064	25,027,462	1.684	66.2

a Includes 260 Otto-Hoffman ovens.
b Production included in Pittsburg district.
c Includes production in Lebanon and Schuylkill valleys.
d Includes 110 Semet-Solvay ovens.
e Includes 130 Semet-Solvay, 4 Rothberg, and 200 Otto-Hoffman ovens.
f Includes production of ovens in Allegheny Valley district.
g Includes 332 Otto-Hoffman and 25 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 260 by-product ovens of the Otto-Hoffman type, which are operated in connection with the Cambria Steel Company of that city. One hundred of these were completed and put in blast in 1904. The production of the district in 1904 was 551,570 short tons against 739,263 short tons in 1903. Of the 2,153 completed ovens in the district, 255 were idle all the year, and one company with 300 ovens reported a total production of only 271 short tons of coke.

The statistics of the manufacture of coke in the Allegheny Mountain district from 1880 to 1904 are as follows:

Statistics of the manufacture of coke in the Allegheny Mountain district of Pennsylvania, 1880–1904.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	8	291	0	201,345	127,525	$289,929	$2.27	63
1881	9	371	0	225,563	144,430	329,198	2.28	64
1882	10	481	0	284,544	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	64.4
1889	16	1,069	20	564,112	354,288	601,964	1.69	63.5
1890	16	1,171	0	633,974	402,514	730,048	1.81	63.5
1891	16	1,201	0	708,523	448,067	782,175	1.75	63
1892	16	1,260	0	724,903	448,522	775,927	1.73	61.9
1893	15	1,260	0	275,865	173,131	264,292	1.53	62.8
1894	15	1,253	0	92,965	58,823	71,161	1.21	63.3
1895	13	1,233	60	271,096	173,965	214,741	1.23	64
1896	13	[a] 1,188	0	408,827	266,473	349,373	1.31	65
1897	13	[a] 1,185	0	417,470	278,578	365,191	1.31	66.7
1898	13	[a] 1,158	[b] 100	572,568	378,410	511,202	1.35	66
1899	13	[c] 1,256	8	730,843	478,340	959,740	2.01	65.5
1900	14	[d] 1,341	0	876,440	557,184	1,260,441	2.26	63.6
1901	16	[d] 1,378	0	864,133	548,076	1,112,682	2.03	63.4
1902	16	[d] 1,563	[e] 380	965,412	644,053	1,782,660	2.768	66.7
1903	16	[c] 2,047	[b] 100	1,116,345	739,263	2,139,569	2.89	66.2
1904	17	[e] 2,153	100	785,105	551,570	1,152,101	2.09	70.3

[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 260 Otto-Hoffman ovens.

Broadtop district.—This district includes the ovens in Bedford and Huntingdon counties, the coal being drawn from the mines of the Broadtop coal field. There are only five establishments in the district, and two of these, comprising 176 ovens, were not in operation in 1904. The production of the Semet-Solvay ovens at Lebanon and at Chester, in the eastern part of the State, has been added to this district for 1903 and 1904.

The statistics of the manufacture of coke in the Broadtop district from 1880 to 1904 are shown in the following table:

Statistics of the manufacture of coke in the Broadtop district, Pennsylvania, 1880–1904.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	Short tons.			Per cent.
1880	5	188	105	92,894	51,130	$123,748	$2.40	55
1881	5	188	105	111,593	66,560	167,074	2.51	59
1882	5	293	50	170,637	105,111	215,079	2.05	62
1883	5	343	110	220,932	147,154	271,692	1.84	66
1884	5	453	0	227,954	151,959	264,569	1.74	66
1885	5	537	0	190,836	112,073	185,656	1.65	58
1886	5	562	100	171,137	108,294	187,321	1.73	63.3
1887	5	581	0	262,730	164,535	347,061	2.11	62.6
1888	5	591	0	196,015	119,469	286,655	2.40	61
1889	5	589	0	152,090	91,256	186,718	2.05	60
1890	5	482	16	247,823	157,208	314,416	2.00	63
1891	5	448	0	146,008	90,728	197,048	2.17	62
1892	5	448	8	185,600	117,554	216,090	1.84	63.3
1893	5	456	14	136,069	86,752	150,196	1.73	63.8
1894	5	454	14	53,216	34,089	51,815	1.52	64
1895	5	460	0	133,276	85,842	150,224	1.75	64.4
1896	5	480	0	111,145	72,175	126,306	1.75	64.9
1897	5	491	15	106,706	66,949	107,430	1.60	62.7
1898	5	500	4	122,820	80,935	124,882	1.543	65.9
1899	5	519	3	161,196	107,258	197,895	1.84	66.5
1900	5	532	0	179,088	113,448	230,580	2.03	63.3
1901	5	571	0	187,715	118,949	237,898	2.00	63.4
1902	5	571	[a] 3	281,320	175,808	594,521	3.38	62.5
1903 [b]	5	571	0	351,507	244,898	748,920	3.06	69.6
1904 [c]	5	606	0	358,807	237,639	645,045	2.71	66.2

[a] Kloman retort ovens.
[b] Includes production and value of coke in by-product ovens at Lebanon.
[c] Includes production and value of coke in by-product ovens at Lebanon and Chester.

Clearfield-Center-Elk district.—This district, as its name implies, includes the ovens located in Clearfield and Center counties and a few ovens recently constructed in Elk County. Nearly one-half, or 380 out of 828, ovens in this district were idle in 1904, and 336 more produced altogether less than 9,000 tons. As a result, the total production decreased from 178,276 short tons in 1903 to 35,931 short tons in 1904.

The statistics of the manufacture of coke in the Clearfield-Center-Elk district for the years 1880 to 1904 are given in table which follows.

Statistics of the manufacture of coke in the Clearfield-Center-Elk district, Pennsylvania, 1880–1904.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	Short tons.			Per cent.
1880	1	0	0	200	100	$200	$2.00	50
1881	2	50	0	20,025	13,350	22,695	1.70	67
1882	1	50	0	25,000	17,160	27,406	1.60	69
1883	1	60	0	26,500	18,696	28,844	1.50	71
1884	1	60	0	33,000	23,431	32,849	1.40	71
1885	2	245	0	69,720	48,103	70,331	1.46	69
1886	3	299	20	84,870	55,810	94,877	1.70	66
1887	6	523	10	154,566	97,852	198,095	2.02	63.3
1888	6	601	0	172,999	115,338	174,220	1.51	66.6
1889	6	671	0	195,473	120,734	215,112	1.78	61.7
1890	7	701	0	331,104	212,286	391,957	1.85	64
1891	7	666	0	293,542	183,911	339,082	1.84	63
1892	7	731	0	231,357	147,819	264,422	1.79	63.9
1893	8	695	0	155,119	98,650	171,482	1.74	63.6
1894	8	694	0	61,428	38,825	51,482	1.33	63
1895	8	695	0	155,088	99,469	131,188	1.32	64
1896	7	666	0	183,056	118,155	164,266	1.39	64.5
1897	7	668	0	230,395	153,517	197,139	1.28	66
1898	7	668	0	215,208	137,265	195,836	1.43	63.8
1899	6	450	50	198,110	130,965	234,527	1.79	66.1
1900	7	568	0	212,196	134,828	283,592	2.10	63.5
1901[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	9	850	0	278,329	178,276	583,906	3.275	64
1904	9	828	0	61,564	35,931	79,746	2.22	58.4

[a] Includes ovens and production and value of coke in Elk County since 1901.

Connellsville district.—The Connellsville district of Pennsylvania, which is the largest coke-producing region in the world, is contained entirely within the counties of Fayette and Westmoreland. The coal occurs in a comparatively narrow synclinal basin or trough, extending in a northeast-southwest direction nearly across the two counties. It lies a short distance east of the city of Pittsburg, and supplies most of the fuel for the iron and steel furnaces of that city and vicinity, the greatest iron manufacturing center in the world. The Connellsville district for a number of years, or until 1903, produced from 40 to 50 per cent of the total output of the United States, the smaller proportion in the last two years being due to the largely increased production from the "Klondike" or Lower Connellsville district in Fayette County.

Connellsville coal is an ideal fuel for coking in beehive ovens, and all but 110 of the 22,695 ovens built in this district up to the close of 1904 are of the beehive type. Connellsville coke is considered by some ironmasters to be without an equal as a blast-furnace fuel, and it is certainly the standard by which all other cokes are judged.

The production of the district in 1904 amounted to 8,883,220 short tons, the smallest output in the last six years. Compared with 1903, when the output was 9,102,391 short tons, the production in 1904 exhibits a decrease of 219,171 tons, while the value decreased from $20,707,442 to $13,990,329, a loss of $6,717,113 or over 33 per cent. The average price per ton declined from $2.27 in 1903 to $1.58 in 1904.

Notwithstanding the unsatisfactory condition of the coke trade in 1904, as shown by the decreased production and heavy decline in value, the number of ovens in the district was increased from 22,563 in 1903 to 22,695 in 1904, and there were more ovens building (1,044) at the close of 1904 than at any time in fifteen years. It will be observed in the following table that the yield of coal in coke in 1903 and 1904 is shown to have been 67.4 per cent. This is probably more than the actual yield, as 66⅔ per cent is considered the maximum yield in coke from Connellsville coal in beehive ovens, and for foundry coke the yield is considerably less than that. The apparently large yield is due to the fact that a large part of the coal charged into the ovens is not weighed but is computed by measurement, and some operators reported as high as 75 and 80 per cent yield, which was evidently erroneous.

The following are the statistics of the manufacture of coke in the Connellsville region from 1880 to 1904:

Statistics of the manufacture of coke in the Connellsville region, Pennsylvania, 1880–1904.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	67	7,211	731	3,367,856	2,205,946	$3,948,643	$1.79	65.5
1881	70	8,208	654	4,018,782	2,639,002	4,301,573	1.63	65.7
1882	72	9,283	592	4,628,736	3,043,394	4,473,789	1.47	65.8
1883	74	10,176	101	5,355,380	3,552,402	4,049,738	1.14	66.3
1884	76	10,543	200	4,829,054	3,192,105	3,607,078	1.13	66.1
1885	68	10,471	48	4,683,831	3,096,012	3,776,388	1.22	66.1
1886	36	11,324	1,895	6,305,460	4,180,521	5,701,086	1.36	66.3
1887	73	11,923	98	6,182,846	4,146,989	7,437,669	1.79	67
1888	38	12,818	1,320	7,191,708	4,955,553	5,884,081	1.19	69
1889	29	14,458	430	8,832,371	5,930,428	7,974,633	1.34	67
1890	28	15,865	30	9,748,449	6,464,156	11,537,370	1.94	66.3
1891	33	17,551	0	7,083,705	4,760,665	8,903,454	1.87	67
1892	31	17,309	0	9,389,549	6,329,452	11,598,407	1.83	67.4
1893	28	17,504	5	7,095,491	4,805,623	7,141,031	1.49	67.7
1894	29	17,829	0	7,656,169	5,192,080	5,405,691	1.04	67.8
1895	29	18,028	80	12,174,597	8,181,179	10,122,458	1.237	67.2
1896	88	a18,347	0	8,107,536	5,462,490	10,018,946	1.834	67.4
1897	86	a18,467	92	10,243,690	6,860,826	10,662,428	1.55	67
1898	88	a18,927	20	12,454,969	8,315,350	12,626,292	1.518	66.8
1899	86	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	99	b22,563	c130	13,498,859	9,102,391	20,707,442	2.27	67.4
1904	101	d22,695	1,044	13,185,690	8,883,220	13,990,329	1.575	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.
d Includes 110 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 1903 and 1904, by months, in cars and tons, with the average number of cars shipped each working day in the month. These shipments include coke made in the Upper and Lower Connellsville districts.

Shipments of coke from the Connellsville region in 1903 and 1904, by months.

Month.	1903.			1904.		
	Cars.	Daily average.	Tons.	Cars.	Daily average.	Tons.
January	47,626	1,764	1,134,272	30,077	1,157	718,382
February	41,783	1,741	958,981	35,319	1,413	845,428
March	53,534	2,059	1,274,863	37,804	1,400	1,062,192
April	55,554	2,137	1,346,053	50,602	1,946	1,118,043
May	53,929	2,074	1,288,550	47,152	1,813	1,146,907
June	56,730	2,182	1,379,257	38,052	1,464	945,520
July	55,285	2,048	1,327,239	36,414	1,400	887,402
August	51,234	1,970	1,211,826	40,301	1,493	975,724
September	51,257	1,970	1,239,265	47,574	1,830	1,153,471
October	42,722	1,582	1,041,966	47,214	1,816	1,148,089
November	27,348	1,094	629,768	49,921	1,920	1,207,131
December	21,736	805	513,187	50,329	1,864	1,219,174
Total	558,738	1,782	13,345,230	510,759	1,623	12,427,463

The monthly shipments of coke from this region in the years 1900 to 1904, as reported by the Courier, are given in the following table:

Monthly shipments of coke from the Connellsville region in the years 1900–1904.

[Short tons.]

Month.	1900.	1901.	1902.	1903.	1904.
January	1,001,882	989,367	1,173,860	1,134,272	718,382
February	910,729	939,756	971,048	958,981	845,428
March	1,044,588	1,150,734	1,133,978	1,274,863	1,062,192
April	982,551	1,070,708	1,219,928	1,346,053	1,118,043
May	934,186	1,084,458	1,300,648	1,288,550	1,146,907
June	872,316	1,075,000	1,234,596	1,379,257	945,520
July	732,981	1,046,996	1,271,045	1,327,239	887,402
August	698,065	1,099,417	1,238,260	1,211,826	975,724
September	673,336	1,011,439	1,246,095	1,239,265	1,153,471
October	734,748	1,128,183	1,230,860	1,041,966	1,148,089
November	751,443	1,070,204	1,079,037	629,768	1,207,131
December	829,409	943,687	1,039,385	513,187	1,219,174
Total	10,166,234	12,609,949	14,138,740	13,345,230	12,427,463

The total shipments, in cars, for the last seventeen years were as follows:

Total and daily average shipments, in cars, 1888–1904.

Year.	Daily average.	Total cars.	Year.	Daily average.	Total cars.
1888	905	282,441	1897	1,181	367,383
1889	1,046	326,220	1898	1,415	441,249
1890	1,147	355,070	1899	1,676	523,203
1891	884	274,000	1900	1,619	504,410
1892	1,106	347,012	1901	1,857	581,051
1893	874	270,930	1902	1,986	624,198
1894	900	281,677	1903	1,782	558,738
1895	1,410	441,243	1904	1,623	510,759
1896	920	289,137			

The following table shows the prices prevailing for Connellsville furnace and foundry coke during the years 1900, 1901, 1902, 1903, and 1904. The abnormally high prices reported for both grades of coke in 1902 and 1903 were for coke sold for prompt delivery.

Prices of Connellsville furnace and foundry coke, 1900–1904, by months.

Month.	Furnace.						
	1900.	1901.	1902.		1903.		1904.
			Contract price.	For prompt delivery.	Six months' contracts.	Prompt delivery.	
Jan	$2.75 to $3.50	$1.75	$2.25	$2.50 to $3.50	$3.75 to $4.00	$6.00 to $7.00	$1.60 to $1.65
Feb	2.75 to 3.50	1.75	2.25	2.50 to 3.00	3.50 to 4.00	4.50 to 5.50	1.50 to 1.65
Mar	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	1.60 to 1.75
Apr	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	1.60 to 1.65
May	3.00 to 3.25	2.00	2.25 to 2.50	....	3.00 to 3.50	3.50 to 4.00	1.60 to 1.65
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	1.40 to 1.65
July	2.00 to 2.50	1.75 to 2.00	2.25	3.00 to 4.00	2.50	2.50	1.40 to 1.50
Aug	2.00	1.75 to 2.00	2.25	3.50 to 4.00	2.25 to 2.50	2.00 to 2.50	1.45 to 1.50
Sept	2.00	1.75 to 2.00	3.00	4.00 to 5.00	2.25 to 2.50	2.00 to 2.50	1.40 to 1.50
Oct	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	1.45 to 1.65
Nov	2.00	1.85 to 2.00	3.50 to 4.00	7.00 to 8.00	....	1.65 to 2.00	1.75 to 2.15
Dec	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	2.10 to 2.45

Month.	Foundry.					
	1900.	1901.	1902.[a]	1903.[a]	1903.[b]	1904.
Jan	$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	$2.10 to $2.50
Feb	3.00 to 4.00	2.25	2.75 to 3.00	(c)	6.00 to 7.00	2.10 to 2.25
Mar	3.75 to 4.50	2.50	2.75 to 3.00	(c)	6.00 to 7.00	2.10 to 2.50
Apr	3.25 to 4.50	2.50	2.75 to 3.00	5.00	5.50 to 6.00	2.15 to 2.50
May	3.00 to 3.50	2.50	2.75 to 3.00	4.00	4.00 to 5.50	2.00 to 2.15
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	1.80 to 2.00
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	1.75 to 1.85
Aug	2.75	2.25 to 2.50	2.75 to 3.00	3.00	3.00	1.75 to 1.85
Sept	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	1.75 to 2.00
Oct	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	1.80 to 2.25
Nov	2.25 to 2.50	2.25 to 2.50	4.50 to 5.00	....	2.50 to 2.65	2.00 to 2.50
Dec	2.25 to 2.50	2.35 to 2.50	4.50 to 5.00	....	2.15 to 2.50	2.25 to 2.50

[a] Contract prices. [b] Prompt delivery. [c] No contract prices quoted.

The prices quoted in the above table are for strictly Connellsville coke as reported by the Iron Age. "Main line" and "outside" brands are usually quoted from 15 to 25 cents below strict Connellsville.

Greensburg district.—The statistics of coke production in the Greensburg district for 1904 record the first setback to a steadily increasing output for ten years. The production in 1904 amounted to 314,954 short tons against 451,385 tons in 1903. There was no change in the number of establishments or ovens. One plant of 10 ovens was idle during all of 1904.

Statistics of the manufacture of coke in the Greensburg district, Pennsylvania, 1889–1904.

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	7	1,332	0	813,216	451,385	1,477,134	3.27	55.5
1904	7	1,332	0	511,303	314,954	551,228	1.75	61.6

Irwin district.—This district includes the ovens located near the town of Irwin, in Westmoreland County, and also those located in what may be termed the Irwin basin, on the Youghiogheny River. More than half of the ovens in the district were idle all of last year, and the others were operated but a short time during the year. The production dropped from 133,290 short tons in 1903 to 8,793 tons in 1904.

Statistics of the manufacture of coke in the Irwin district, Pennsylvania, 1889–1904.

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	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
1904	6	691	0	14,468	8,793	14,576	1.66	60.8

Lower Connellsville district.—This district, sometimes called the "Klondike," is located in the western part of Fayette County, immediately west of the southern end of the Connellsville basin, from which it is separated by the Greensburg anticline. Although but five years old, having been opened in 1900, it ranks next to Connellsville among the coke-making districts in the United States, having in 1904 an output more than double that of the Flat Top district of West Virginia, which until 1902 was the second coke-producing region in the United States. While outside of the Connellsville basin, the coking qualities of the coal compare favorably with that of Connellsville, and the coke is marketed as Connellsville coke. It is the only district in Pennsylvania whose production of coke in 1904 exceeded that of 1903, the output of the Lower Connellsville district exhibiting an increase of 558,158 short tons, or 24 per cent, while the total production in the State decreased 789,868 tons, or 5.05 per cent. The number of establishments in the district increased from 32 to 34, and the number of ovens from 5,753 to 6,570. There were only four establishments idle during the year, one of which consisted of only 30 and another of but 47 ovens. The other two were the new plants added to the list in 1904, whose ovens were not completed and put in blast before the close of the year.

The record of the district for the five 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, Pennsylvania, 1900–1904.

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	32	5,753	786	3,452,568	2,329,298	5,522,884	2.37	67.5
1904	34	6,570	250	4,229,755	2,887,456	4,623,133	1.60	68.2

Lebanon Valley and Schuylkill districts.—The bank of Otto-Hoffman ovens at Lebanon were not in operation during 1904. The Semet-Solvay plant of 90 ovens at the same place was completed and put in blast early in 1904, and was active the greater part of the year. The 40 ovens of the Semet-Solvay type which were building in 1903 were also put in blast in 1904 and continued in operation the remainder of the year. The production from these two plants amounted to 110,365 tons, or nearly 900 tons to the oven.

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 877,640 short tons in 1903 to 841,459 tons in 1904. There was a decrease of 1 in the number of establishments, and an increase of 559 in the number of ovens. The new ovens included 159 Otto-Hoffman by-product ovens which were reported as under construction in 1903.

Statistics of the manufacture of coke in the Pittsburg district, Pennsylvania, 1880–1904.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1880	21	534	0	194,393	105,974	$254,500	$2.40	55
1881	21	538	0	178,509	96,310	206,965	2.15	54
1882	21	557	0	114,956	64,779	134,378	2.07	56.3
1883	20	542	0	119,310	66,820	126,020	1.89	56
1884	20	535	0	97,367	53,857	99,911	1.87	55
1885	17	416	4	91,101	46,930	72,509	1.55	51.5
1886	18	730	0	228,874	138,646	221,617	1.88	60.6
1887	20	880	235	366,184	177,097	315,546	1.78	48.4
1888	22	980	0	428,899	264,156	350,818	1.33	62
1889	17	600	21	233,571	141,324	283,402	2.00	60.5
1890	14	541	0	149,230	93,984	171,465	1.82	63
1891	13	590	11	154,054	94,160	201,458	2.14	61
1892	15	725	261	292,357	176,365	376,613	2.14	60.3
1893	10	885	0	357,400	216,268	438,801	2.03	60.5
1894	9	779	104	371,569	227,100	351,825	1.55	61
1895	9	973	0	452,845	232,529	547,284	2.35	51.3
1896	11	1,264	*a* 120	583,984	368,070	941,076	2.56	63
1897	9	*b* 1,233	200	832,505	548,981	864,326	1.57	66
1898	10	*c* 1,100	168	836,948	552,742	899,537	1.627	66
1899	10	*c* 1,312	505	954,028	644,467	1,189,117	1.84	67.6
1900	*d* 8	*c* 1,641	0	862,610	570,678	1,418,382	2.48	66.1
1901 *g*	*e* 10	*c* 1,651	*f* 227	1,266,947	813,478	1,690,614	2.078	64.2
1902 *g*	*h* 10	*c* 1,611	*f* 232	1,488,973	953,863	1,924,942	2.018	64.1
1903 *g*	*h* 9	*i* 1,636	*j* 359	1,404,660	877,640	2,632,827	3.00	62.5
1904 *g*	*h* 8	*k* 2,195	0	1,370,629	841,459	1,795,257	2.13	61.4

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.
k Includes 332 Otto-Hoffman and 25 Semet-Solvay 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, Central and Hudson River Railway. The production in 1904 amounted to 709,502 short tons, as compared with 810,359 tons in 1903. One establishment of 100 ovens was added to the district in 1904, 2 ovens were abandoned, and 200 new ovens were building at the close of the year.

The following are the statistics of the manufacture of coke in the Reynoldsville-Walston district for the years 1880 to 1904:

Statistics of the manufacture of coke in the Reynoldsville-Walston district, Pennsylvania, 1880–1904.

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	3	117	0	45,055	28,090	$46,359	$1.65	62
1881	4	125	2	99,489	44,260	80,785	1.85	44
1882	5	177	0	87,314	44,709	80,339	1.80	51
1883	6	229	0	76,580	37,044	65,584	1.77	48
1884	7	321	0	159,151	78,646	113,155	1.44	49
1885	8	600	143	183,806	114,409	153,795	1.35	62
1886	9	783	500	271,037	161,828	217,834	1.35	59.7
1887	11	1,492	134	507,320	316,107	592,728	1.88	62.3
1888	9	1,636	100	404,346	253,662	320,203	1.26	62.7
1889	8	1,747	0	514,461	313,011	436,857	1.40	60.8
1890	8	1,737	0	652,966	406,184	771,996	1.90	62
1891	7	1,747	0	769,100	470,479	744,098	1.58	61
1892	8	1,734	0	683,539	425,250	743,227	1.75	62.2
1893	8	1,755	0	562,033	339,314	586,212	1.73	60.4
1894	8	1,755	0	336,554	207,238	297,596	1.44	61.6
1895	8	1,637	0	504,092	296,820	357,266	1.20	58.9
1896[a]	7	1,852	34	770,104	445,998	673,625	1.51	57.9
1897[a]	6	1,980	0	810,808	491,267	759,609	1.55	60.6
1898[a]	5	1,942	0	1,022,196	600,084	846,121	1.41	58.7
1899[a]	6	1,779	0	1,581,164	972,933	1,793,807	1.84	61.5
1900	7	2,010	0	1,115,923	625,553	1,347,869	2.15	56
1901	7	2,010	0	1,059,107	589,577	1,171,878	1.988	55.7
1902	7	2,029	0	1,251,765	689,890	1,422,143	2.06	55.1
1903	7	2,003	0	1,420,709	810,359	2,688,472	3.32	57.4
1904	8	2,101	200	1,313,507	709,502	1,585,950	2.235	54

[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 the district in 1904 amounted to 390,540 short tons, a decrease of over 50 per cent from that of 1903. The large decrease in this district may be attributed to the fact that strictly Connellsville coke was in greater supply and at much reduced prices, as compared with 1903.

Statistics of the manufacture of coke in the Upper Connellsville district, Pennsylvania, 1880–1904.

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	649,316	1,111,056	1.71	65
1892	14	1,843	0	706,171	451,975	691,323	1.53	64
1893	14	1,843	0	499,809	320,793	447,090	1.39	64
1894	14	1,843	0	279,971	176,799	212,595	1.20	63
1895	14	1,849	30	319,285	208,158	251,892	1.21	65
1896	14	1,863	0	617,601	406,112	570,687	1.405	65.7
1897	14	1,863	0	556,941	345,372	444,709	1.29	62
1898	13	1,832	0	638,277	403,045	538,609	1.34	63
1899	13	1,861	68	933,792	609,893	986,298	1.62	65.3
1900	14	1,999	0	1,042,170	690,449	1,378,629	1.996	66.2
1901	16	2,082	100	852,448	569,511	1,033,991	1.815	66.8
1902	17	2,132	405	1,413,476	936,854	2,193,332	2.34	66.3
1903	19	2,556	280	1,180,947	784,132	2,133,513	2.72	66.4
1904	19	2,660	27	601,236	390,540	590,097	1.51	64.9

TENNESSEE.

By a decrease in coke production from 546,875 short tons in 1903 to 379,240 tons in 1904, Tennessee dropped from sixth to seventh place among the coke-producing States. The coke product of Tennessee is for the most part consumed in the iron furnaces of Chattanooga and vicinity and other points in the eastern part of the State.

There was a gain of 1 in the number of establishments in 1904, as compared with 1903, and a decrease of 3 in the number of completed ovens. Two of the older establishments, having a total of 245 ovens, did not make any coke during 1904, while 4 new concerns, having a total of 110 ovens completed and 190 ovens building, had not had any of the ovens fired up before the close of the year.

The statistics of the manufacture of coke in Tennessee for the years 1880 to 1904 are given in the table which follows.

Statistics of the manufacture of coke in Tennessee, 1880–1904.

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
1904	17	2,436	190	718,181	379,240	905,540	2.388	52.8

[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, 1890–1904.

[Short tons.]

Year.	Run of mine. Unwashed.	Run of mine. Washed.	Slack. Unwashed.	Slack. Washed.	Total.
1890	255,359	0	273,028	72,000	600,387
1891	184,556	0	377,914	60,707	623,177
1892	176,453	15,000	367,827	40,846	600,126
1893	179,126	0	137,483	132,902	449,511
1894	166,990	61,841	149,958	138,013	516,802
1895	96,744	59,284	285,906	242,721	684,655
1896	0	206,319	219,231	174,829	600,379
1897	36,485	400,166	119,755	111,590	667,996
1898	37,217	306,969	122,756	255,414	722,356
1899	140,804	267,105	31,805	340,236	779,995
1900	150,697	349,448	24,122	330,522	854,789
1901	224,723	282,129	34,088	198,306	739,246
1902	287,064	334,109	47,161	357,530	1,025,864
1903	157,717	404,949	74,560	364,130	1,001,356
1904	1,471	302,943	60,784	352,983	718,181

UTAH.

As there is but one company 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 development of the coking industry in the southwestern counties of Virginia during the last ten years has been exceptionally rapid, and the year just passed is the first since 1893 in which the production has shown a decrease as compared with the preceding year. In 1893 there were but 2 establishments in the State, the number of ovens completed was 594, and the total production amounted to 125,092 short tons. In 1903, the year of maximum production, there were 16 establishments, having a total of 4,251 ovens, and the output amounted to 1,176,439 tons. The statistics for 1904 show an increase of 94 in the number of completed ovens, the number of establishments remaining as in 1903, while the production declined to 1,101,716 short tons, a decrease of 74,723 tons, or 6.35 per cent. The value of the product declined from $2,724,047 in 1903 to $1,772,717, a decrease of $951,330, or 35 per cent. Two establishments, having a total of 107 ovens, were idle throughout 1904. One of the idle establishments was the plant of Newton-Chambers ovens at Pocahontas.

Practically all of the new work in the last few 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.

The following are the statistics of the manufacture of coke in Virginia from 1883 to 1904:

Statistics of the manufacture of coke in Virginia, 1883–1904.

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	*a*1,564	0	852,972	531,161	699,781	1.317	62
1899	6	*a*1,588	429	994,635	618,707	1,071,284	1.73	62.2
1900	7	*a*2,331	300	1,083,827	685,156	1,464,556	2.137	63.2
1901	7	*a*2,775	0	1,400,231	907,130	1,483,670	1.635	64.7
1902	14	*a*2,974	1,208	1,716,110	1,124,572	2,322,228	2.065	65.5
1903	16	*a*4,251	142	1,860,225	1,176,439	2,724,047	2.315	63.2
1904	16	*a*4,345	68	1,636,905	1,101,716	1,772,717	1.609	67.3

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, 1890–1904.

[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
1904	1,213,226	44,222	379,457	0	1,636,905

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 1904, the same as in 1903. Three of the 6 plants were idle, however, throughout the whole of 1903 and 1904. These 3 idle plants included altogether 71 ovens. The 3 plants which made coke included 185 ovens. Production in the State was almost exactly the same in the last two years, that of 1904 being 191 tons less than that of 1903. There have been no new ovens building at the close of the last three years.

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, 1884–1904.

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.*
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
1904	6	256	0	76,993	45,432	207,357	4.56	59

WEST VIRGINIA.

Because of a decrease in production of 424,732 short tons in 1904, as compared with 1903, West Virginia once more falls behind Alabama and for the tenth time in twenty years occupies third place in rank among the coke-producing States. Since 1885 Alabama and West

Virginia have been close rivals for second place, each having held it ten times, and during the last four years have alternated each year.

The coke production of West Virginia in 1904 was the smallest in five years, amounting to 2,283,086 short tons, valued at $3,757,850. Compared with the record year of 1903, when the production amounted to 2,707,818 short tons, valued at $7,115,842, this shows a decrease of 424,732 short tons, or 15.69 per cent in quantity, and of $3,357,992, or 47 per cent in value.

The number of establishments increased from 136 in 1903 to 137 in 1904, a gain of 1. The number of completed ovens increased from 15,613 to 16,929, a gain of 1,316, and there were 1,319 ovens building at the close of 1904. There were 32 establishments, having a total of 1,789 ovens, idle during 1904. Of these, 21 plants, with 1,002 ovens, were in the upper Monongahela district; 8, having 499 ovens, were in the New River district; 2, having 178 ovens, were in the Flat Top district; and 1, of 110 ovens, was in the Kanawha district.

The following table exhibits the statistics of coke production in West Virginia since 1880:

Statistics of the manufacture of coke in West Virginia, 1880–1904.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
1880	18	631	40	230,758	138,755	$318,797	$2.30	60
1881	19	689	0	304,823	187,126	429,571	2.30	61
1882	22	878	0	366,653	230,398	520,437	2.26	63
1883	24	962	9	411,159	257,519	563,490	2.19	63
1884	27	1,005	127	385,588	223,472	425,952	1.91	62
1885	27	978	63	415,533	260,571	485,588	1.86	63
1886	29	1,100	317	425,002	264,158	513,843	1.94	62
1887	39	2,080	742	698,327	442,031	976,732	2.21	63.3
1888	51	2,764	318	854,531	525,927	896,797	1.71	61.5
1889	53	3,438	631	1,001,372	607,880	1,074,177	1.76	60
1890	55	4,060	334	1,395,266	833,377	1,524,746	1.83	60
1891	55	4,621	555	1,716,976	1,009,051	1,845,043	1.83	58.8
1892	72	5,843	978	1,709,183	1,034,750	1,821,965	1.76	60.5
1893	75	7,354	132	1,745,757	1,062,076	1,716,907	1.62	60.8
1894	78	7,858	60	1,976,128	1,193,933	1,639,687	1.373	60.4
1895	78	7,834	55	2,087,816	1,285,206	1,724,239	1.34	61.6
1896	84	8,351	28	2,687,104	1,649,755	2,259,999	1.37	61.4
1897	84	8,404	38	2,413,283	1,472,666	1,933,808	1.31	61
1898	87	[a] 8,659	161	3,145,398	1,925,071	2,432,657	1.26	61.2
1899	87	[a] 8,846	[b] 619	3,802,825	2,278,577	3,480,408	1.53	60
1900	106	[c] 10,249	1,306	3,868,840	2,358,499	4,746,633	2.01	60.9
1901	112	[c] 11,544	1,254	3,734,076	2,283,700	4,110,011	1.80	61.1
1902	120	[c] 12,656	2,341	4,078,579	2,516,505	5,833,226	2.318	61.7
1903	136	[c] 15,613	2,687	4,347,160	2,707,818	7,115,842	2.628	62.3
1904	137	[c] 16,929	1,319	3,543,338	2,283,086	3,757,850	1.646	64.4

[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 (nearly 70 per cent) of the coal used in coke making in West Virginia is slack, and of this 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
1904	1,247,935	1,350	2,128,251	165,802	3,543,338

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 district includes the ovens along the line of the Chesapeake and Ohio Railroad and its branches from Quinnimont on the east to Hawks Nest, near which point the coals of the New River series go below water level. The Kanawha district embraces all of the ovens along the Kanawha River and its tributaries from Mount Carbon to the western limit of the coal fields. The ovens of the Gauley Mountain Coal Company at Ansted are included in the New River district, although the Ansted coal belongs in reality to the Kanawha series and lies about 1,000 feet above the New River coals. 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 1904 increased in one district only—the Flat Top—and this increase was due, not to any greater activity in the Flat Top district proper, but to the production by the United States Coal and Coke Company in the Tug River region, whose ovens and output have been added to the Flat Top district.

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 1903, by districts.

District.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
Flat Top[a]	51	8,994	1,329	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.

Production of coke in West Virginia in 1904, by districts.

District.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	*Short tons.*			*Per cent.*
Flat Top[a]	53	10,023	684	2,024,055	1,320,314	$1,928,871	$1.46	65.2
Kanawha	13	1,112	100	152,517	92,014	142,858	1.55	60.3
New River	27	2,156	518	387,265	233,014	439,521	1.89	60.2
Upper Monongahela	37	[b]2,348	17	478,513	328,820	749,305	2.28	68.7
Upper Potomac and Tygarts Valley	7	1,290	0	500,988	308,924	497,295	1.61	61.7
Total	137	16,929	1,319	3,543,338	2,283,086	3,757,850	1.646	64.4

[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 lower 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 Flat Top district has included that of the Tug River district, in which the United States Coal and Coke Company had built 1,341 ovens up to the close of 1904 and had 519 ovens building December 31. The Flat Top district (including Tug River) was the only district in the State in which the production in 1904 exceeded that of 1903, and in this case the increase was only 5,556 short tons—from 1,314,758 short tons in 1903 to 1,320,314 tons in 1904. Two new establishments were added to the district in 1904, the ovens of neither of which were fired up during the year. One other plant of 128 ovens was idle throughout 1904. The statistics of production in this district since its beginning in 1886 are as follows:

Statistics of the manufacture of coke in the Flat Top district of West Virginia, 1886–1904.

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	571,239	1.75	57.5
1891	19	1,889	358	537,847	312,421	545,367	1.70	58
1892	30	2,848	933	595,734	353,696	596,911	1.69	59.3
1893	34	4,349	80	746,051	451,503	713,261	1.58	60.5
1894	36	4,648	18	1,229,136	746,762	989,876	1.325	60.7
1895	36	4,648	18	858,913	524,252	656,494	1.25	61
1896	36	4,648	18	1,400,369	852,120	1,100,312	1.291	60.8
1897	36	4,648	18	1,172,206	720,988	868,484	1.20	61.5
1898	36	4,667	27	1,701,404	1,057,626	1,216,059	1.15	62.2
1899	35	4,623	214	1,861,570	1,138,389	1,453,601	1.28	61.1
1900 [a]	38	5,290	666	1,952,274	1,208,838	2,290,947	1.895	61.9
1901	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	62.3
1903	51	8,994	1,329	2,094,127	1,314,758	3,126,512	2.38	62.8
1904	53	10,023	684	2,024,055	1,320,314	1,928,871	1.46	65.2

[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 the junction of the New and Gauley rivers. The ovens at Ansted on Gauley Mountain are included in this district, although the coal belongs by right to the Kanawha series. The coals of the New River district are for the most part high-grade coking coals, and the coke product is much prized as a blast-furnace fuel. The production in 1904, owing largely to labor troubles at the mines, was the smallest in ten years, amounting to 233,014 short tons. Compared with 1903 this exhibits a decrease of 135,830 short tons, or nearly 37 per cent. The value declined from $1,129,701 to $439,521, a loss of $690,180, or 61 per cent.

The statistics of the manufacture of coke in the New River district from 1880 to 1904 are as follows:

Statistics of the manufacture of coke in the New River district, West Virginia, 1880–1904.

Year.	Establishments.	Ovens.		Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
		Built.	Building.					
				Short tons.	Short tons.			Per cent.
1880	6	468	40	159,032	98,427	$239,977	$2.14	62
1881	6	499	0	219,446	136,423	334,652	2.45	62
1882	6	518	0	233,361	148,373	352,415	2.38	64
1883	6	546	0	264,171	167,795	384,552	2.29	64
1884	8	547	12	219,839	135,335	274,988	2.03	62
1885	8	519	0	244,769	156,007	325,001	2.08	63.8
1886	8	513	5	203,621	127,006	281,778	2.22	62
1887	11	518	50	253,373	159,836	401,164	2.51	63
1888	12	743	0	334,695	199,831	390,182	1.95	60
1889	12	773	0	268,185	157,186	351,132	2.23	58.6
1890	12	773	4	275,458	174,295	377,847	2.17	63
1891	13	787	102	309,073	193,711	426,630	2.20	63
1892	14	965	0	315,511	196,359	429,376	2.19	62
1893	13	947	10	281,600	178,049	355,955	2.00	63
1894	14	1,089	0	222,900	140,842	245,154	1.74	63.2
1895	14	978	0	385,899	244,815	404,978	1.65	63.4
1896	17	1,259	0	425,219	269,372	443,072	1.64	63.3
1897	17	1,225	0	439,103	268,263	419,151	1.56	61.1
1898	18	1,299	4	519,937	317,998	484,001	1.52	61
1899	22	1,444	167	503,160	281,134	533,996	1.90	56
1900	27	1,722	560	568,856	341,527	750,637	2.198	60
1901	28	2,128	261	657,003	399,373	823,060	2.06	60.8
1902	27	2,156	175	521,973	317,086	981,753	3.096	60.8
1903	28	2,243	500	619,230	368,844	1,129,701	3.06	59.5
1904	27	2,156	518	387,265	233,014	439,521	1.89	60.2

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 1889. 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. Notwithstanding this new construction, however, and the addition of 145 completed ovens in 1904, the production fell off nearly 50 per cent, from 179,988 short tons in 1903 to 92,014 short tons in 1904. Labor troubles, short car supply, and slack demand for coke all helped to restrict production.

The statistics of the manufacture of coke in the Kanawha district from 1880 to 1904 are as follows:

Statistics of the manufacture of coke in the Kanawha district, West Virginia, 1880–1904.

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	138	0	40,782	26,170	62,808	2.40	64
1883	5	147	0	58,735	37,970	88,090	2.32	64.6
1884	6	177	15	60,281	39,000	76,070	1.95	64.6
1885	7	181	63	65,348	37,551	63,082	1.68	57
1886	7	302	170	89,410	54,329	117,649	2.17	60.7
1887	7	548	0	153,784	96,721	201,418	2.08	63
1888	9	572	8	141,641	84,052	146,837	1.75	59
1889	6	474	0	109,466	63,678	117,340	1.84	58
1890	6	474	0	182,340	104,076	196,583	1.89	57
1891	6	474	0	241,427	134,715	276,420	2.05	56
1892	6	506	0	242,627	140,641	284,174	2.02	58
1893	6	506	0	215,108	122,241	237,308	1.94	56.8
1894	6	506	0	176,746	104,160	181,586	1.74	58.9
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
1904	13	1,112	100	152,517	92,014	142,858	1.55	60.3

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 1904 was 108,702 short tons, or nearly 25 per cent, less than that of 1903, which in turn was 20 per cent less than that of 1902. Of the 37 establishments and 2,348 ovens in the district in 1904, 21 plants having 1,002 ovens were idle the entire year.

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, 1880–1904.

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	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	*c* 2,319	337	724,915	437,522	1,315,336	3.01	60.3
1904	37	*c* 2,348	17	478,513	328,820	749,305	2.28	68.7

a Includes 60 Semet-Solvay ovens at Wheeling.
b All Semet-Solvay ovens at Wheeling.
c Includes 120 Semet-Solvay ovens at Wheeling.

Upper Potomac and Tygarts Valley 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, 1903, and 1904 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 of the district in 1904, notwithstanding the fact that none of the plants was idle all the year, shows a decrease of 97,782 short tons, or about 24 per cent, as compared with 1903. This is the only district in the State in which all of the establishments located in it made coke in 1904.

The statistics of the manufacture of coke in the Upper Potomac and Tygarts Valley district are shown in the following table:

Statistics of the manufacture of coke in the Upper Potomac and Tygarts Valley district, of West Virginia, 1887–1904.

Year.	Establishments.	Ovens. Built.	Ovens. Building.	Coal used.	Coke produced.	Total value of coke at ovens.	Value of coke at ovens, per ton.	Yield of coal in coke.
				Short tons.	*Short tons.*			*Per cent.*
1887	1	20	50	3,565	2,211	$4,422	$2.00	62
1888	1	28	0	9,176	5,835	8,752	1.50	64
1889	2	84	0	26,105	17,945	28,559	1.58	69
1890	2	178	28	94,983	61,971	118,503	1.91	65
1891	2	390	39	111,014	76,599	133,549	1.75	69
1892	3	395	0	114,045	78,691	121,208	1.54	69
1893	3	394	0	123,492	84,607	115,250	1.36	68.5
1894	2	394	0	66,598	43,546	43,546	1.00	65.4
1895	2	442	0	183,187	110,753	126,595	1.14	60.5
1896	2	482	0	270,275	164,093	242,133	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
1904	7	1,290	0	500,988	308,924	497,295	1.61	61.7

OTHER STATES.

In the following table are presented the statistics of production in 1900, 1901, 1902, 1903, and 1904 of those States in which there are but one or two establishments. These States are Illinois, Indiana, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New Mexico, New York, Wisconsin, and Wyoming.

Of the several States included in this statement, six of them—Maryland, Michigan, Minnesota, 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, Minnesota, New Jersey, New York, and Michigan are by-product retort ovens. One of the two establishments in Wisconsin is also a by-product recovery plant, and one plant of 120 by-product ovens is building at Chicago, Ill.

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.

The statistics of production in the States having less than three establishments since 1900 are shown in the following table:

Statistics of coke production from 1900 to 1904 in States having only one or two establishments.

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	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
1904	14	[i] 1,753	[j] 658	2,046,340	1,469,845	4,830,621	3.286	71.8

[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.
[i] Includes 270 Semet-Solvay and 1,047 Otto-Hoffman ovens.
[j] Otto-Hoffman ovens.

Of the total production of 1,469,845 short tons in 1904, shown in the preceding table, 1,390,885 short tons, or 95 per cent, were made in by-product retort ovens. This is a little more than half of the total production of by-product coke in 1904.

GAS, COKE, TAR, AND AMMONIA.[a]

By Edward W. Parker.

INTRODUCTION.

In compliance with a somewhat general demand for information on the production of coke and gas, and particularly on the output of the by-products of coal tar and ammonia, a special chapter on these subjects was prepared by Dr. William B. Phillips and published in Mineral Resources for 1898. The edition of this report was soon exhausted, and the rapid increase in the production of coke in by-product ovens during the last few years has created a demand for an annual report on the lines suggested by the one prepared by Doctor Phillips. Accordingly, since 1902, this chapter has been added to the other statistical reviews in Mineral Resources.

The statistics contained in this report cover the production of coke, gas, tar, and ammonia by the carbonization of coal at gas works and in retort or by-product recovery coke ovens in the United States, but do not include water gas or gas made exclusively from petroleum, rosin, wood, etc. In a few instances some oil is used with the coal in the production of gas, and, as no separation of this can be made, it is necessarily included with the product.

In 1898 there were 433 companies manufacturing gas from coal in the United States, which reported their production to this office. The statistics for 1902 included reports from 533 companies, those for 1903 from 528 companies, and 534 companies reported their production in 1904. The report for 1898, however, did not include the gas production of the 520 by-product coke ovens in operation at that time. In 1902 there were 1,663 by-product coke ovens in operation; in 1903 there were 1,956 of this type of ovens in blast, and in 1904 the number had increased to 2,910, while 832 were in course of construction. The statistics of the production of coke in these ovens is included in the more extended chapter on the manufacture of coke, but are repeated here as being of interest in the discussion of the by-products from all gas and coke works.

[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.

The total quantity of coal carbonized at gas works and in by-product ovens in 1904 was 7,058,157 short tons, almost equally divided between the gas and the oven plants. In 1903 the total quantity of coal carbonized was 5,843,538 short tons, of which 2,605,453 tons were coked in by-product ovens, and 3,238,085 tons were used at gas works, showing that 80 per cent of the increased consumption in 1904 was in that used by retort coke ovens.

The total production in 1904 was 34,814,991,273 cubic feet of gas, 4,716,049 short tons of coke, 69,498,085 gallons of tar, 52,244,392 gallons of ammonia liquor (equivalent to 19,774,986 pounds of anhydrous ammonia), and 28,200,256 pounds of ammonia sulphate, against a production in 1903 of 31,049,461,511 cubic feet of gas, 3,941,282 short tons of coke, 62,964,393 gallons of tar, 64,605,311 gallons of ammonia liquor (equivalent to 17,643,507 pounds NH_3), and 12,400,032 pounds of ammonia sulphate. The total value of all these products in 1904 was $51,157,736, against $47,830,600 in 1903.

In the following table is presented a statement of the quantity of coal carbonized, and the quantity of gas, coke, and tar produced at gas works and in by-product ovens in 1904. No separation was made of the production of ammonia. It should be stated here that by the production of gas in by-product ovens is meant the amount of surplus gas sold. No record is kept of the quantity of gas actually produced at by product oven plants. Most of the gas made is consumed in the process or used under boilers, and some is allowed to escape into the air.

The amount of gas sold at gas works per ton of coal coked was 8,639 cubic feet in 1904, as compared with 1,317 cubic feet sold at by-product coke oven plants. Estimating that each ton of coal coked at these works would produce 10,000 cubic feet of gas, the output of gas from by-product works in the United States in 1904 would have been 35,729,490,000 cubic feet.

Coal consumed,[a] and gas, coke, and tar produced at gas works and in by-product coke ovens in the United States in 1904.

Kind of product.	Gas works.	By-product coke plants.	Total.
Coal coked ....short tons..	3,485,208	3,572,949	7,058,157
Gas produced and sold....cubic feet..	30,109,449,125	4,705,542,148	34,814,991,273
Coke produced....short tons..	2,107,820	2,608,229	4,716,049
Tar produced....gallons..	41,726,970	27,771,115	69,498,085

PRODUCTION OF GAS.

The quantity of gas produced at by-product coke works and in gas-house retorts in 1904, as reported by 534 establishments, amounted to 37,671,839,673 cubic feet. Of this quantity 2,856,848,400 cubic feet was "unaccounted for," having been lost through leakage, fire, or otherwise. The net product sold amounted, therefore, to 34,814,991,273 cubic feet, which was valued at $32,090,998, or an average of 92 cents per thousand cubic feet. In 1903 the quantity of gas produced and sold by 533 establishments was 31,049,461,511 cubic feet, valued at $30,315,776, or 97 cents per thousand. The increase in production in 1904, therefore, amounted to 3,765,529,762 cubic feet, or 12 per cent, with a gain of $1,775,222, or 6 per cent, in value, the comparatively lower value in 1904 having been due to the higher price of coal in 1903.

Of the total gas made and sold in 1904, 25,864,097,184 cubic feet were sold for illuminating and 8,950,894,089 cubic feet for fuel purposes. These figures compare with 22,953,792,437 cubic feet of illuminating and 8,095,669,074 cubic feet of fuel gas sold in 1903.

New York continues to hold first place in rank of producing importance, the quantity of gas made and sold in that State in 1904 amounting to a little over 5,265,000,000 cubic feet. Ohio ranks second, with 4,510,000,000 cubic feet; Massachusetts third, with 4,477,000,000 cubic feet; Pennsylvania fourth, with 2,871,000,000; and Michigan fifth, with 2,823,000,000 cubic feet. Ohio holds second place in the total quantity of gas sold by reason of the large amount used in that State for fuel purposes, over 1,366,000,000 cubic feet being so consumed in 1904. In this particular Ohio ranks first, with Michigan second, Illinois third, Wisconsin fourth, New York fifth, and Missouri sixth.

In the quantity of coal carbonized, Pennsylvania and Massachusetts both exceeded New York, this fact being due to the comparatively large amount of coal used in by-product coke ovens, the greater part of the gas produced therein being used in the coking process.

In the following table is shown a statement of the production of gas in 1903 and 1904, by States, with the quantity and value of that sold for illuminating and fuel purposes and the quantity lost or unaccounted for. It will be observed that prices for artificial gas are usually low in the States where it comes into competition with natural gas, such as Indiana, Ohio, Kentucky, Pennsylvania, and West Virginia, and also in Maryland, Massachusetts, and Wisconsin, where considerable proportions of the total production are made in by-product coke ovens.

Quantity and value of gas produced and sold at by-product coke plants and coal-gas works of the 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	a 576,480	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	a 299,326	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	a 862,114	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	a 350,664	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
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	5,516,347,012	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 546,367	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	6,224	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.

Quantity and value of gas produced and sold at by-product coke plants and coal-gas works of the United States in 1904, 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	523,490	238,389,415	118,469,150	$147,364	$1.24	87,838,750	$96,409	$1.10	206,307,900	$243,773	$1.18	32,081,515
Arkansas	5	7,546	64,697,480	33,838,620	58,833	1.74	28,360,880	42,144	1.49	62,199,500	100,977	1.62	2,497,980
California	3	4,143	38,218,370	23,486,888	42,149	1.79	13,770,910	23,381	1.70	37,257,798	65,530	1.76	960,572
Colorado	4	44,929	452,053,500	172,112,600	232,561	1.35	248,984,000	249,644	1.00	421,096,600	482,205	1.145	30,956,900
Connecticut	9	40,833	391,620,697	258,774,111	307,799	1.19	110,095,855	126,601	1.15	368,869,966	434,400	1.18	22,750,731
Delaware	3	14,331	130,523,200	93,498,352	94,598	1.01	34,724,048	34,824	1.00	128,222,400	129,422	1.01	2,300,800
Florida, Louisiana, and Mississippi	5	6,815	55,500,000	26,662,750	42,445	1.59	18,962,750	23,664	1.25	45,625,500	66,109	1.45	9,874,500
Georgia	9	46,515	411,245,631	239,189,869	275,171	1.15	169,996,412	178,132	1.05	409,186,281	453,303	1.11	2,059,350
Idaho, North Dakota, Utah, and Wyoming	5	9,749	97,094,000	19,159,900	33,213	1.73	52,370,200	71,865	1.37	71,530,100	105,078	1.47	25,563,900
Illinois	47	203,311	1,899,788,190	873,233,250	1,012,068	1.16	857,637,350	916,934	1.07	1,730,870,600	1,929,002	1.11	168,917,590
Indiana	30	110,691	990,455,700	603,099,694	587,484	.97	291,773,906	289,606	.99	894,873,600	877,090	.98	95,582,100
Indian Territory and Oklahoma	3	1,327	11,898,000	4,498,850	4,544	1.01	5,930,150	5,954	1.00	10,429,000	10,498	1.00	1,469,000
Iowa	16	49,821	477,915,100	219,387,660	281,551	1.28	213,912,340	253,092	1.18	433,300,000	534,643	1.23	44,615,100
Kansas	11	32,478	271,950,880	109,356,605	151,264	1.38	134,220,380	161,655	1.20	243,576,985	312,919	1.28	28,373,895
Kentucky	12	78,925	739,682,830	421,413,470	453,952	1.08	227,930,050	173,962	.76	649,343,520	627,914	.97	90,339,310
Maine	7	19,350	187,870,280	116,889,125	172,372	1.47	49,036,425	56,298	1.15	165,925,550	228,670	1.38	21,944,730
Maryland and District of Columbia	8	529,030	1,419,379,410	1,400,273,564	548,605	.39	11,760,000	12,310	1.05	1,412,033,564	560,915	.40	7,345,846
Massachusetts	45	897,406	4,677,148,820	4,039,492,138	2,871,160	.71	437,564,492	503,124	1.15	4,477,056,630	3,374,284	.75	200,092,190
Michigan	37	493,440	3,021,097,576	1,904,053,353	1,277,355	.67	919,033,047	848,696	.92	2,823,086,400	2,126,051	.75	198,011,176
Minnesota	6	116,451	746,279,761	550,137,335	620,858	1.13	131,093,092	154,324	1.18	681,230,427	775,182	1.14	65,049,334
Missouri	20	192,352	1,721,449,200	877,209,672	915,026	1.04	695,902,448	584,594	.84	1,573,112,120	1,499,620	.95	148,337,080
Montana, Nevada, and New Mexico	5	7,179	68,438,333	30,831,078	71,330	2.31	28,142,555	54,789	1.95	58,973,633	126,119	2.14	9,464,700
Nebraska	3	5,820	50,586,200	24,829,050	34,049	1.37	22,757,150	28,084	1.23	47,586,200	62,133	1.31	3,000,000

New Hampshire and Vermont....	7	21,673	207,158,200	147,038,233	197,594	1.34	42,445,411	53,005	1.25	189,483,644	250,599	1.32	17,674,556
New Jersey........	15	238,100	1,247,220,218	967,120,752	1,045,051	1.08	216,084,689	234,264	1.08	1,183,205,441	1,279,315	1.08	64,014,777
New York	55	832,041	5,682,016,080	4,503,230,726	4,584,606	1.02	762,206,743	794,120	1.04	5,265,437,469	5,378,726	1.02	416,578,611
North Carolina....	6	8,160	64,743,400	40,910,100	64,327	1.57	19,366,700	21,638	1.12	60,276,800	85,965	1.43	4,466,600
Ohio...............	46	588,804	5,086,884,432	3,144,353,983	2,426,101	.77	1,366,349,395	922,501	.68	4,510,703,378	3,348,602	.74	576,181,054
Oregon	3	1,953	16,751,200	9,610,000	23,900	2.49	6,764,200	13,152	1.94	16,374,200	37,052	2.26	377,000
Pennsylvania	30	1,163,733	3,025,053,824	2,676,015,601	2,605,825	.97	195,265,401	114,847	.59	2,871,281,002	2,720,672	.95	153,772,822
Rhode Island......	3	49,790	493,889,200	292,229,150	345,222	1.18	156,460,800	167,204	1.07	448,689,950	512,426	1.14	45,199,250
South Carolina	3	13,076	122,689,000	70,481,350	101,978	1.45	32,500,050	40,043	1.23	102,981,400	142,021	1.38	19,707,600
Tennessee.........	8	69,678	615,173,565	318,370,695	339,673	1.07	198,421,870	199,485	1.00	516,792,565	539,158	1.04	98,381,000
Texas	9	16,560	149,975,575	60,512,600	106,525	1.76	78,677,900	105,437	1.34	139,190,500	211,962	1.52	10,785,075
Virginia...........	13	49,247	447,928,210	317,968,979	348,962	1.10	71,726,171	79,797	1.11	389,695,150	428,759	1.10	58,233,060
Washington	7	36,800	352,181,376	168,012,441	220,813	1.31	166,364,759	219,089	1.32	334,377,200	439,902	1.31	17,804,176
West Virginia	7	231,070	165,153,600	129,253,600	99,913	.77	2,900,000	4,350	1.15	132,153,600	104,263	.79	33,000,000
Wisconsin	18	301,540	1,831,739,220	859,091,890	750,235	.87	843,562,810	735,504	.87	1,702,654,700	1,485,739	.87	129,084,520
Total	534	a7,05,157	37,671,839,673	25,864,097,184	23,496,476	.908	8,950,894,089	8,594,522	.96	34,814,991,273	32,090,998	.92	2,856,848,40[illegible]

a Includes coal coked in by-product coke ovens.

Of the total production of 37,671,839,673 cubic feet of gas made in 1904, 2,856,848,400 cubic feet, or 8 per cent, were lost by leakage, fire, or otherwise, as compared with a loss of 2,433,969,478 cubic feet, or 7 per cent, out of a total production of 33,483,430,989 cubic feet in 1903. The largest losses in 1904 were shown in the combined production of Idaho, North Dakota, Utah, and Wyoming, and in West Virginia. The smallest losses were reported in Georgia (0.5 per cent), in Maryland and the District of Columbia (1 per cent), in Delaware and Oregon (2 per cent), in California (3 per cent), and in Massachusetts and Arkansas (4 per cent). There were four States in which the loss amounted to 5 per cent, and fourteen in which the loss amounted to from 6 to 9 per cent.

In the following table is shown the total quantity of gas produced in each State, ranged according to rank, in 1903 and 1904, with the quantity and percentage of the gas sold, and lost or unaccounted for. Part of the gas unaccounted for is used by the companies producing it and is not really a loss.

Rank of States in gas production and the quantity sold and unaccounted for in 1903 and 1904, by States.

Rank.	State.	Total production.	Gas sold.		Gas unaccounted for.	
			Quantity.	Per cent.	Quantity.	Per cent.
	1903.	*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

Rank of States in gas production and the quantity sold and unaccounted for, etc.—Cont'd.

Rank.	State.	Total production.	Gas sold.		Gas unaccounted for.	
			Quantity.	Per cent.	Quantity.	Per cent.
	1903.	*Cubic feet.*	*Cubic feet.*		*Cubic feet.*	
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
	1904.					
1	New York	5,682,016,080	5,265,437,469	93	416,578,611	7
2	Ohio	5,086,884,432	4,510,703,378	89	576,181,054	11
3	Massachusetts	4,677,148,820	4,477,056,630	96	200,092,190	4
4	Pennsylvania	3,025,053,824	2,871,281,002	95	153,772,822	5
5	Michigan	3,021,097,576	2,823,086,400	93	198,011,176	7
6	Illinois	1,899,788,190	1,730,870,600	91	168,917,590	9
7	Wisconsin	1,831,739,220	1,702,654,700	93	129,084,520	7
8	Missouri	1,721,449,200	1,573,112,120	91	148,337,080	9
9	Maryland and District of Columbia	1,419,379,410	1,412,033,564	99	7,345,846	1
10	New Jersey	1,247,220,218	1,183,205,441	95	64,014,777	5
11	Indiana	990,455,700	894,873,600	90	95,582,100	10
12	Minnesota	746,279,761	681,230,427	91	65,049,334	9
13	Kentucky	739,682,830	649,343,520	88	90,339,310	12
14	Tennessee	615,173,565	516,792,565	84	98,381,000	16
15	Rhode Island	493,889,200	448,689,950	91	45,199,250	9
16	Iowa	477,915,100	433,300,000	91	44,615,100	9
17	Colorado	452,053,500	421,096,600	93	30,956,900	7
18	Virginia	447,928,210	389,695,150	87	58,233,060	13
19	Georgia	411,245,631	409,186,281	99.5	2,059,350	.5
20	Connecticut	391,620,697	368,869,966	94	22,750,731	6
21	Washington	352,181,376	334,377,200	95	17,804,176	5
22	Kansas	271,950,880	243,576,985	90	28,373,895	10
23	Alabama	238,389,415	206,307,900	87	32,081,515	13
24	New Hampshire and Vermont	207,158,200	189,483,644	91	17,674,556	9
25	Maine	187,870,280	165,925,550	88	21,944,730	12
26	West Virginia	165,153,600	132,153,600	80	33,000,000	20
27	Texas	149,975,575	139,190,500	93	10,785,075	7
28	Delaware	130,523,200	128,222,400	98	2,300,800	2
29	South Carolina	122,689,000	102,981,400	85	19,707,600	15
30	Idaho, North Dakota, Utah, and Wyoming	97,094,000	71,530,100	74	25,563,900	26
31	Montana, Nevada, and New Mexico	68,438,333	58,973,633	86	9,464,700	14
32	North Carolina	64,743,400	60,276,800	93	4,466,600	7
33	Arkansas	64,697,480	62,199,500	96	2,497,980	4
34	Florida, Louisiana, and Mississippi	55,500,000	45,625,500	82	9,874,500	18
35	Nebraska	50,586,200	47,586,200	94	3,000,000	6
36	California	38,218,370	37,257,798	97	960,572	3
37	Oregon	16,751,200	16,374,200	98	377,000	2
38	Indian Territory and Oklahoma	11,898,000	10,429,000	88	1,469,000	12
	Total	37,671,839,673	34,814,991,273	92	2,856,848,400	8

About three-fourths of all the gas produced and sold is used for illuminating purposes, 74 per cent being so consumed in 1904, as compared with 75 per cent in 1903 and 80.45 per cent in 1902. The increase from 19.55 per cent of fuel gas consumed in 1902 to 26 per cent in 1904 illustrates quite forcibly the growing popularity of gas for cooking and other household purposes. The actual quantity of gas consumed for fuel purposes has increased nearly 60 per cent in two years, or from 5,677,755,029 cubic feet in 1902 to 8,950,894,089 cubic feet in 1904.

The following table shows the total quantity of gas sold in 1903 and 1904, by States, with the quantity and percentage used for illuminating and fuel purposes:

Quantity of illuminating and fuel gas sold in 1903 and 1904, by States.

State.	Total sales.	Illuminating.		Fuel.	
		Quantity.	Percentage.	Quantity.	Percentage.
1903.	*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
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	537,234,200	357,176,200	67	180,058,000	33
South Carolina	95,876,900	66,508,100	69	29,368,800	31
Tennessee	527,263,212	335,988,786	64	191,274,426	36
Texas	131,610,100	75,515,000	58	56,095,100	42

Quantity of illuminating and fuel gas sold in 1903 and 1904, by States—Continued.

State.	Total sales.	Illuminating.		Fuel.	
		Quantity.	Percentage.	Quantity.	Percentage.
1903.	*Cubic feet.*	*Cubic feet.*		*Cubic feet.*	
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
1904.					
Alabama	206,307,900	118,469,150	57	87,838,750	43
Arkansas	62,199,500	33,838,620	54	28,360,880	46
California	37,257,798	23,486,888	63	13,770,910	37
Colorado	421,096,600	172,112,600	41	248,984,000	59
Connecticut	368,869,966	258,774,111	70	110,095,855	30
Delaware	128,222,400	93,498,352	73	34,724,048	27
Florida, Louisiana, and Mississippi	45,625,500	26,662,750	58	18,962,750	42
Georgia	409,186,281	239,189,869	58	169,996,412	42
Idaho, North Dakota, Utah, and Wyoming	71,530,100	19,159,900	27	52,370,200	73
Illinois	1,730,870,600	873,233,250	50	857,637,350	50
Indiana	894,873,600	603,099,694	67	291,773,906	33
Indian Territory and Oklahoma	10,429,000	4,498,850	43	5,930,150	57
Iowa	433,300,000	219,387,660	51	213,912,340	49
Kansas	243,576,985	109,356,605	45	134,220,380	55
Kentucky	649,343,520	421,413,470	65	227,930,050	35
Maine	165,925,550	116,889,125	70	49,036,425	30
Maryland and District of Columbia	1,412,033,564	1,400,273,564	99	11,760,000	1
Massachusetts	4,477,056,630	4,039,492,138	90	437,564,492	10
Michigan	2,823,086,400	1,904,053,353	67	919,033,047	33
Minnesota	681,230,427	550,137,335	81	131,093,092	19
Missouri	1,573,112,120	877,209,672	56	695,902,448	44
Montana, Nevada, and New Mexico	58,973,633	30,831,078	52	28,142,555	48
Nebraska	47,586,200	24,829,050	52	22,757,150	48
New Hampshire and Vermont	189,483,644	147,038,233	78	42,445,411	22
New Jersey	1,183,205,441	967,120,752	82	216,084,689	18
New York	5,265,437,469	4,503,230,726	86	762,206,743	14
North Carolina	60,276,800	40,910,100	68	19,366,700	32
Ohio	4,510,703,378	3,144,353,983	69	1,366,349,395	31
Oregon	16,374,200	9,610,000	59	6,764,200	41
Pennsylvania	2,871,281,002	2,676,015,601	93	195,265,401	7
Rhode Island	448,689,950	292,229,150	65	156,460,800	35
South Carolina	102,981,400	70,481,350	68	32,500,050	32
Tennessee	516,792,565	318,370,695	62	198,421,870	38
Texas	139,190,500	60,512,600	43	78,677,900	57
Virginia	389,695,150	317,968,979	82	71,726,171	18
Washington	334,377,200	168,012,441	50	166,364,759	50
West Virginia	132,153,600	129,253,600	98	2,900,000	2
Wisconsin	1,702,654,700	859,091,890	50	843,562,810	50
Total	34,814,991,273	25,864,097,184	74	8,950,894,089	26

PRODUCTION OF COKE.

The total quantity of coke produced in retort or by-product recovery ovens and at gas works in the United States in 1904 amounted to 4.716.049 short tons, valued at $14.693.126, as compared with 3,941,282 short tons, valued at $13.634.095 in 1903, and 3.377.763 short tons, valued at $11.267.608 in 1902. Of the total product in 1904, 2.107,820 short tons were produced at gas works and 2,608.229 short tons in retort ovens. In 1903 the production of gas-house coke amounted to 2.058.888 short tons and that of retort-oven coke to 1.882.394 short tons, and in 1902 the production of gas-house coke was 1.974.175 short tons, while that from retort ovens was 1.403.588 short tons. It is seen from this that while in two years the output of coke from gas works has increased only 133.645 tons or 6.7 per cent, that from retort ovens has increased 1.204,641 short tons or 86 per cent.

The total quantity of coal carbonized or coked at gas works and by-product coke plants in 1904 was 7.058.157 short tons, almost equally divided, 3.485.208 short tons being used in gas works and 3.572.949 in retort ovens. In 1903 out of 5.843.538 short tons 3.238.085 short tons were consumed at gas works and 2.605.453 short tons in retort ovens.

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 table gives the production of coke at gas works and in by-product ovens in 1903 and 1904, 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 1903 and 1904.

Rank.	State.	Number of establishments.	Quantity.	Value.	Value per ton.	Yield of coal in coke.
	1903.		*Short tons.*			*Per cent.*
1	Massachusetts	45	599,320	$2,123,771	$3.54	69.5
2	Pennsylvania	31	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	153,623	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	3.93	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	58.8
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	3	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
	1904.					
1	Pennsylvania	30	813,768	1,906,309	2.34	69.9
2	Massachusetts	45	626,170	2,078,298	3.32	60.9
3	New York	55	508,920	1,689,105	3.32	61.2
4	Maryland and District of Columbia	8	369,123	1,288,456	3.49	69.8
5	Alabama	11	363,301	744,745	2.05	69.4
6	Ohio	46	356,023	976,032	2.74	60.5
7	Michigan	37	339,955	1,073,888	3.16	68.9

Rank of States in production of coke in gas works and by-product ovens, etc.—Continued.

Rank.	State.	Number of establishments.	Quantity.	Value.	Value per ton.	Yield of coal in coke.
	1904.		*Short tons.*			*Per cent.*
8	Wisconsin	18	219,049	$898,949	$4.10	72.6
9	West Virginia	7	168,800	493,009	2.92	73.1
10	New Jersey	15	162,697	499,756	3.07	68.3
11	Illinois	47	122,612	462,854	3.77	60.3
12	Missouri	20	121,685	429,265	3.53	63.3
13	Minnesota	6	82,028	369,875	4.51	70.4
14	Indiana	30	65,485	211,686	3.23	59.1
15	Kentucky	12	53,298	123,235	2.31	67.5
16	Tennessee	8	45,681	163,262	3.57	65.5
17	Rhode Island	3	32,318	140,605	4.35	64.9
18	Colorado	4	30,797	126,718	4.11	68.5
19	Iowa	16	29,660	141,042	4.75	59.5
20	Virginia	13	27,337	98,387	3.60	55.5
21	Connecticut	9	24,730	102,868	4.16	60.6
22	Georgia	9	24,583	90,204	3.67	52.8
23	Washington	7	24,345	78,765	3.24	66.2
24	Kansas	11	19,160	71,132	3.71	59.0
25	New Hampshire and Vermont	7	14,638	72,778	4.97	67.5
26	Maine	7	12,045	68,159	5.65	62.3
27	Texas	9	10,114	60,895	6.02	61.1
28	South Carolina	3	10,107	46,250	4.57	77.3
29	Delaware	3	7,350	22,200	3.02	51.3
30	Arkansas	5	4,996	19,300	3.86	66.2
31	Idaho, North Dakota, Utah, and Wyoming	5	4,823	28,307	5.87	49.5
32	North Carolina	6	4,597	20,253	4.40	56.3
33	Florida, Louisiana, and Mississippi	5	4,096	16,056	3.92	60.1
34	Montana, Nevada, and New Mexico	5	3,808	23,993	6.30	53.0
35	Nebraska	3	3,528	20,420	5.79	60.6
36	California	3	2,485	23,607	9.50	60.0
37	Oregon	3	1,147	7,559	6.59	58.7
38	Indian Territory and Oklahoma	3	790	4,904	6.20	59.5
	Total	534	4,716,049	14,693,126	3.12	66.8

PRODUCTION OF COAL TAR.

The total production of coal tar in the United States in 1904 amounted to 69,498,085 gallons, valued at $2,114,421, an average of 3.04 cents per gallon. Of the total product, 41,726,970 gallons, or 60 per cent, were produced at gas works, and 27,771,115 gallons, or 40 per cent, in by-product coke ovens. In 1903 the total production of coal tar was 62,964,393 gallons, valued at $2,199,969. The yield of tar per ton of coal consumed in 1904 ranged from 7.09 gallons in California to 14.4 gallons in Oregon, the average yield for the United States being 9.85 gallons. Prices ranged from 2.04 cents per gallon in Maryland and the District of Columbia to as high as 10 cents in Oregon.

The following table exhibits the production of coal tar in 1903 and 1904, by States, arranged according to their producing importance:

Rank of States in coal-tar production in 1903 and 1904.

Rank.	State.	Number of establishments.	Quantity.	Value.	Value per gallon.	Yield per ton of coal.
	1903.		*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	11.55
26	Maine	7	239,287	12,872	5.38	13.35
27	Texas	8	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	6.03
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
	1904.					
1	Massachusetts		9,392,898	301,130	3.2	10.47
2	Pennsylvania		9,007,569	213,757	2.4	7.74
3	New York		7,771,046	209,470	2.7	9.34
4	Ohio		[b]6,867,555	214,717	3.1	11.71
5	Michigan		[c]4,957,578	124,792	2.5	10.12
6	Alabama		4,354,115	105,372	2.42	8.32

[a] Includes some tar made in water-gas manufacture.
[b] In addition 30,000 gallons were produced and unsold.
[c] In addition 42,112 gallons were produced and unsold, there being no market.

Rank of States in coal-tar production in 1903 and 1904—Continued.

Rank.	State.	Number of establishments.	Quantity.	Value.	Value per gallon.	Yield per ton of coal.
	1904.		*Gallons.*		*Cents.*	*Gallons.*
7	Maryland and District of Columbia	......	4,229,906	$86,415	2.04	8
8	Wisconsin	......	3,470,338	117,441	3.4	11.51
9	Missouri	......	[a]2,481,941	109,922	4.4	12.94
10	West Virginia	......	2,409,452	79,030	3.28	10.43
11	New Jersey	......	2,360,366	75,278	3.2	9.91
12	Illinois	......	2,297,257	77,196	3.36	11.3
13	Indiana	......	1,302,893	48,305	3.7	11.77
14	Kentucky	......	924,908	21,816	2.35	11.7
15	Minnesota	......	910,711	27,720	3.04	10.67
16	Tennessee	......	896,986	39,057	4.35	12.87
17	Rhode Island	......	674,615	26,004	3.85	13.55
18	Georgia	......	649,040	25,065	3.86	13.95
19	Iowa	......	604,253	19,919	3.29	12.13
20	Colorado	......	589,187	24,270	4.1	13.11
21	Washington	......	508,543	27,999	5.5	13.82
22	Virginia	......	503,460	18,119	3.6	10.22
23	Connecticut	......	496,683	25,153	5.1	12.16
24	Kansas	......	323,212	13,496	4.18	9.95
25	Maine	......	264,047	11,487	4.3	13.64
26	New Hampshire and Vermont	......	243,741	12,756	5.2	11.25
27	Texas	......	185,364	13,838	7.5	11.2
28	Delaware	......	150,300	5,472	3.6	10.49
29	South Carolina	......	141,016	6,045	4.3	10.8
30	Idaho, North Dakota, Utah, and Wyoming	......	127,840	6,464	5.06	13.11
31	Arkansas	......	78,711	4,493	5.7	10.43
32	North Carolina	......	78,322	3,551	4.5	9.6
33	Florida, Louisiana, and Mississippi	......	63,537	4,510	7.1	9.32
34	Montana, Nevada, and New Mexico	......	56,763	5,569	9.8	7.9
35	Nebraska	......	52,855	3,450	6.5	9.08
36	California	......	29,387	1,763	6	7.09
37	Oregon	......	28,120	2,812	10	14.40
38	Indian Territory and Oklahoma	......	13,570	768	5.6	10.23
	Total	......	69,498,085	2,114,421	3.04	9.85

[a] In addition 7,083 gallons were produced and unsold.

PRODUCTION OF AMMONIA.

Only about one-fifth of the establishments producing gas and coke from coal report the recovery of ammonia either in the form of ammoniacal liquor or as sulphate. Thus, in 1904, out of a total of 534 establishments the ammonia production was reported by but 117. These companies reported a production in 1904 of 52,244,392 gallons of ammonia liquor, valued at $1,488,693, and 28,200,256 pounds of sulphate, valued at $770,498. In 1903 the production of liquor reported by 115 companies amounted to 64,605,311 gallons, valued at $1,291,732, and that of sulphate to 12,400,032 pounds, valued at $389,028. From this it is observed that although there was a decrease of over 12,000,000 gallons in the production of ammonia liquor in 1904 as compared with 1903, the value of the product showed an increase of nearly $200,000, and that the production of sulphate in 1904 was considerably more than double that of the preceding year, with an increase of nearly 100 per cent in value.

The total quantity of coal carbonized at the works reporting a production of ammonia in 1904 was 6,115,588 short tons, of which 5,246,651 tons were used at works producing ammonia liquor, and 868,937 tons at works reporting their production in the form of sulphate. In 1903 the establishments making ammonia liquor carbonized 4,233,126 short tons of coal, and those making sulphate used 654,037 short tons of coal. The average yield of ammonia liquor and sulphate per ton of coal consumed in 1904 was 10 gallons of liquor and 32 pounds of sulphate.

The returns showed that ammonia liquor is sold in several ways. Some companies reported the production in liquor ounces, selling at a 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 is 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 table shows the production and value of ammoniacal liquor at gas and by-product coke works in 1903 and 1904:

Production and value of ammoniacal liquor at gas and by-product coke works of the United States in 1903 and 1904.

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	3,474
20,255	799,123	5.126	1.78	88,902	6.92	3,154
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
150,210	1,564,463	16.00	5.57	544,628	21.60	26,024
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

Production and value of ammoniacal liquor at gas and by-product coke works, etc.—Cont'd.

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.*					
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
263,351	105,401	64.00	22.26	146,639	86.39	61,173
151,489	361,044	65.00	22.61	530,846	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	37,230
11,744	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	91,407	72.00	25.05	143,110	97.19	12,711
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
4,233,126	64,605,311	....	....	17,643,507	....	1,291,732

1904.

Coal carbonized.	Quantity of ammonia liquor made and sold.	In ounces.	Ounces per gallon.	Total in pounds.	Equivalent to sulphate of ammonia (ounces per gallon).	Total value of ammonia liquor.
17,408	549,277	3.00	1.04	35,703	4.05	$1,735
46,674	1,653,700	4.00	1.39	143,665	5.40	4,585
11,810	369,075	4.75	1.65	38,061	6.41	1,402
6,835	250,400	4.77	1.66	25,979	6.44	1,194
30,324	645,646	4.8	1.67	67,389	6.48	5,165
23,387	812,627	4.86	1.69	85,834	6.56	2,370
404,320	15,162,107	6.00	2.09	1,980,550	8.10	84,793
7,816	240,502	6.3	2.19	32,919	8.50	1,655
53,866	1,958,460	6.7	2.33	285,201	9.04	14,493
68,115	2,143,942	7.00	2.44	326,605	9.45	10,703
123,264	4,036,564	7.12	2.48	624,911	9.61	46,868
5,844	116,890	7.2	2.51	18,337	9.72	1,375
282,510	10,965,248	7.44	2.59	1,775,000	10.04	64,695
73,096	2,050,944	8.00	2.78	356,352	10.80	15,755
3,500	25,000	9.6	3.34	5,219	12.96	378
21,980	268,000	10.00	3.48	58,290	13.50	3,015
10,336	40,257	10.5	3.65	9,184	14.17	475
22,048	454,938	11.5	4.00	113,735	15.52	3,185
275,746	2,648,803	16.00	5.57	922,116	21.60	52,033
3,939	7,736	18.00	6.26	3,027	24.30	197
65,869	647,089	18.8	6.54	264,498	25.38	24,466
12,715	22,572	32.00	11.14	15,828	43.20	1,029

Production and value of ammoniacal liquor at gas and by-product coke works, etc.—Cont'd.

1904—Continued.

Coal carbonized.	Quantity of ammonia liquor made and sold.	Strength of liquor. In ounces.	Strength of liquor. Equivalent to anhydrous ammonia (NH_3). Ounces per gallon.	Strength of liquor. Equivalent to anhydrous ammonia (NH_3). Total in pounds.	Strength of liquor. Equivalent to sulphate of ammonia (ounces per gallon).	Total value of ammonia liquor.
Short tons.	*Gallons.*					
31,104	17,340	33.94	11.81	12,799	45.81	$842
3,692	7,925	35.52	12.36	6,122	47.95	429
14,414	290,594	36.00	12.52	227,390	48.60	5,685
1,907	10,000	38.00	13.22	8,263	51.29	500
27,979	22,675	40.00	13.92	19,727	53.99	1,271
6,200	13,600	40.2	13.99	11,891	54.26	721
12,230	53,574	42.00	14.61	48,920	56.69	2,955
2,685	5,900	44.00	15.31	5,646	59.39	394
21,308	84,781	48.00	16.70	88,491	64.79	6,976
4,300	3,000	48.68	16.94	3,176	65.71	150
7,856	5,161	51.04	17.76	5,729	68.90	430
33,764	119,317	52.00	18.09	134,903	70.19	9,183
2,400	3,045	52.8	18.37	3,496	71.27	244
25,203	81,370	54.00	18.79	95,560	72.89	7,208
8,553	10,872	54.24	18.87	12,822	73.22	574
20,758	29,756	54.72	19.04	35,410	73.86	2,678
3,750	8,151	55.00	19.13	9,746	74.24	797
11,000	17,100	55.6	19.34	20,670	75.04	1,550
34,221	90,748	56.00	19.48	110,486	75.58	6,603
6,563	16,000	56.16	19.54	19,540	75.81	687
11,235	24,626	58.00	20.18	31,060	78.29	2,485
36,932	114,233	60.00	20.87	149,004	80.99	11,685
67,210	227,016	62.00	21.57	306,045	83.69	28,755
170,094	402,473	62.28	21.67	545,099	84.07	48,136
13,038	4,807	62.76	21.83	6,558	84.70	547
163,616	639,026	63.00	21.92	875,466	85.04	80,543
59,585	102,802	64.00	22.26	143,025	86.39	11,975
11,794	10,189	65.48	22.78	14,506	88.39	1,160
65,669	190,713	66.48	23.13	275,700	89.74	24,813
511,833	104,738	68.00	23.66	154,880	91.79	14,464
199,158	559,550	72.96 73.12	25.38 25.44	887,983	98.49 98.70	64,439
120,581	184,226	76.00	26.44	304,433	102.59	29,280
356,500	508,897	76.2 76.72	26.51 26.69	844,371	102.85 103.56	83,222
160,861	320,767	80.00	27.83	557,934	107.98	43,439
168,979	464,571	84.52	29.40	853,649	114.09	74,380
109,405	198,472	100.00	34.79	431,552	134.99	43,099
626,579	988,363	103.80 104.64	36.11 36.40	2,235,740	140.11 141.25	211,871
464,557	1,091,570	113.76 114.44	39.58 39.81	2,708,558	153.56 154.48	279,508
77,736	146,667	119.24	41.48	380,233	160.96	43,449
5,246,651	52,244,392	....	....	19,774,986	....	1,488,693

Production of ammonia in 1903 and 1904, by States.

State.	Coal carbonized.	Ammonia liquor produced.	Equivalent to anhydrous ammonia (NH_3).
1903.	*Short tons.*	*Gallons.*	*Pounds.*
Alabama and Georgia	591,239	1,555,834	3,182,170
Colorado, Oregon, and Washington	61,801	1,003,911	211,465
Connecticut and Rhode Island	69,282	2,190,692	367,934
Delaware and New Jersey	210,593	1,521,991	741,674
Illinois	93,899	231,565	239,720
Indiana	47,478	50,245	61,534
Kentucky and Tennessee	131,635	2,726,717	482,652
Maine and New Hampshire	23,499	163,989	61,584
Maryland and District of Columbia	296,027	1,169,967	220,031
Massachusetts	744,944	2,433,688	857,922
Michigan	287,229	12,796,980	1,286,953
Minnesota and Wisconsin	135,564	407,017	513,002
Missouri	173,384	6,787,901	866,932
New York	569,370	14,514,289	2,755,695
Ohio	434,572	13,265,377	2,000,492
Pennsylvania	797,166	3,028,012	2,685,275
Virginia and West Virginia	219,481	757,136	1,108,472
Total	4,887,163	64,605,311	17,643,507
Quantity of ammonia produced and sold as sulphate (pounds)		12,400,032	
1904.			
Alabama and Georgia	533,629	989,484	1,695,930
Colorado and Washington	56,552	1,122,280	178,596
Connecticut and Rhode Island	50,835	1,525,450	238,636
Delaware and New Jersey	229,430	1,849,032	1,093,520
Illinois	97,859	294,808	299,407
Indiana	26,895	48,534	56,014
Kentucky	66,283	2,067,460	338,049
Maine and New Hampshire	24,207	181,202	58,250
Maryland and District of Columbia	521,686	1,298,920	175,972
Massachusetts	235,194	2,750,414	907,662
Michigan	433,545	2,048,500	2,120,027
Minnesota	106,599	166,778	261,401
Missouri	164,059	5,398,468	746,448
New York	528 631	12,102,997	2,665,694
Ohio	464,575	14,009,575	2,240,007
Pennsylvania	1,143,210	4,152,583	4,082,353
Tennessee	65,041	477,754	164,013
Virginia and West Virginia	238,461	1,183,096	1,336,085
Wisconsin	259,960	577,057	1,116,922
Total	5,246,651	52,244,392	19,774,986
Quantity of ammonia produced and sold as sulphate (pounds)		28,200,256	

Production of ammonia at gas and by-product coke works of the United States in 1903 and 1904.

	1903.	1904.
Coal carbonized at works which produced and sold ammonia liquor, short tons	4,233,126	5,246,651
Coal carbonized at works which produced sulphate of ammonia .short tons	654,037	868,937
Total coal carbonized ...do	4,887,163	6,115,588
Ammonia liquor produced and sold ...gallons	64,605,311	52,244,392
Equivalent to anhydrous ammonia (NH_3) ...pounds	17,643,507	19,774,986
Equivalent to sulphate of ammonia ...do	68,456,807	76,726,946
Ammonia produced and sold as sulphate ...do	12,400,032	28,200,256
Value received for ammonia liquor	$1,291,732	$1,488,693
Value received for sulphate of ammonia	389,028	770,498
Total value received	1,680,760	2,259,191

AGGREGATE PRODUCTION AND VALUE.

In the following tables are shown the quantity and value of the gas, tar, coke, and ammonia produced in the United States in 1903 and 1904, by States. The aggregate value of these products in 1904 was $51,157,736, as compared with $47,830,600 in 1903 and with $43,869,440 in 1902.

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	1,521,991	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	216,833	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	3,028,012	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	64,605,311	3,941,282	2,433,969,478

Production of coal gas and by-products in the United States in 1904, by States.

State.	Gas produced and used for illuminating and fuel purposes.	By-products. Tar.	Anhydrous ammonia, NH_3.	Coke.	Gas unaccounted for.
	Cubic feet.	*Gallons.*	*Pounds.*	*Short tons.*	*Cubic feet.*
Alabama	206,307,900	4,354,115	1,695,930	363,301	32,081,515
Georgia	409,186,281	649,040		24,583	2,059,350
Arkansas	62,199,500	78,711	....	4,996	2,497,980
California	37,257,798	29,387	....	2,485	960,572
Colorado	421,096,600	589,187	178,596	30,797	30,956,900
Washington	334,377,200	508,543		24,345	17,804,176
Connecticut	368,869,966	496,683	238,636	24,730	22,750,731
Rhode Island	448,689,950	674,615		32,318	45,199,250
Delaware	128,222,400	150,300	1,093,520	7,350	2,300,800
New Jersey	1,183,205,441	2,360,366		162,697	64,014,777
Florida, Louisiana, and Mississippi	45,625,500	63,537	....	4,096	9,874,500
Idaho, North Dakota, Utah, and Wyoming	71,530,100	127,840	....	4,823	25,563,900
Illinois	1,730,870,600	2,297,257	299,407	122,612	168,917,590
Indiana	894,873,600	1,302,893	56,014	65,485	95,582,100
Indian Territory and Oklahoma	10,429,000	13,570	....	790	1,469,000
Iowa	433,300,000	604,253	....	29,660	44,615,100
Kansas	243,576,985	323,212	....	19,160	28,373,895
Kentucky	649,343,520	924,908	338,049	53,298	90,339,310
Maine	165,925,550	264,047	58,250	12,045	21,944,730
New Hampshire and Vermont	189,483,644	243,741		14,638	17,674,556
Maryland and District of Columbia	1,412,033,564	4,229,906	175,972	369,123	7,345,846
Massachusetts	4,477,056,630	9,392,898	907,662	626,170	200,092,190
Michigan	2,823,086,400	4,957,578	2,120,027	339,955	198,011,176
Minnesota	681,230,427	910,711	261,401	82,028	65,049,334
Missouri	1,573,112,120	2,481,941	746,448	121,685	148,337,080
Montana, Nevada, and New Mexico	58,973,633	56,763	....	3,808	9,464,700
Nebraska	47,586,200	52,855	....	3,528	3,000,000
New York	5,265,437,469	7,771,046	2,665,694	508,920	416,578,611
North Carolina	60,276,800	78,322	....	4,597	4,466,600
Ohio	4,510,703,378	6,867,555	2,240,007	356,023	576,181,054
Oregon	16,374,200	28,120	....	1,147	377,000
Pennsylvania	2,871,281,002	9,007,569	4,082,353	813,768	153,772,822
South Carolina	102,981,400	141,016	....	10,107	19,707,600
Tennessee	516,792,565	896,986	164,013	45,681	98,381,000
Texas	139,190,500	185,364	....	10,114	10,785,075
Virginia	389,695,150	503,460	1,336,085	27,337	58,233,060
West Virginia	132,153,600	2,409,452		168,800	33,000,000
Wisconsin	1,702,654,700	3,470,338	1,116,922	219,049	129,084,520
Total	34,814,991,273	69,498,085	19,774,986	4,716,049	2,856,848,400
Sulphate of ammonia	....	....	28,200,256	....	....

Value of gas and by-products produced in the United States 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	255,939	1,712,994	2,196,156	4,385,144
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	1,680,760	13,634,095	17,503,779	47,830,600
1904.						
Alabama	243,773	105,372	285,872	744,745	1,251,258	1,948,334
Georgia	453,303	25,065		90,204		
Arkansas	100,977	4,493	....	19,300	23,793	124,770
California	65,530	1,763	....	23,607	25,370	90,900
Colorado	482,205	24,270	5,845	126,718	263,597	1,185,704
Washington	439,902	27,999		78,765		
Connecticut	434,400	25,153	8,163	102,868	302,793	1,249,619
Rhode Island	512,426	26,004		140,605		
Delaware	129,422	5,472	91,525	22,200	694,231	2,102,968
New Jersey	1,279,315	75,278		499,756		
Florida, Louisiana, and Mississippi	66,109	4,510	....	16,056	20,566	86,675
Idaho, North Dakota, Utah, and Wyoming	105,078	6,464	....	28,307	34,771	139,849
Illinois	1,929,002	77,196	23,282	462,854	563,332	2,492,334
Indiana	877,090	48,305	16,110	211,686	276,101	1,153,191
Indian Territory and Oklahoma	10,498	768	....	4,904	5,672	16,170

Value of gas and by-products produced in the United States in 1904, by States—Continued.

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.	
Iowa	$534,643	$19,919		$141,042	$160,961	$695,604
Kansas	312,919	13,496		71,132	84,628	397,547
Kentucky	627,914	21,816	$16,854	123,235	161,905	789,819
Maine	228,670	11,487	219,384	68,159	384,564	863,833
New Hampshire and Vermont	250,599	12,756		72,778		
Maryland and District of Columbia	560,915	86,415	11,167	1,288,456	1,386,038	1,946,953
Massachusetts	3,374,284	301,130	347,853	2,078,298	2,727,281	6,101,565
Michigan	2,126,051	124,792	202,106	1,073,888	1,400,786	3,526,837
Minnesota	775,182	27,720	23,934	369,875	421,529	1,196,711
Missouri	1,499,620	109,922	50,973	429,265	590,160	2,089,780
Montana, Nevada, and New Mexico	126,119	5,569		23,993	29,562	155,681
Nebraska	62,133	3,450		20,420	23,870	86,003
New York	5,378,726	209,470	203,576	1,689,105	2,102,151	7,480,877
North Carolina	85,965	3,551		20,253	23,804	109,769
Ohio	3,348,602	214,717	127,689	976,032	1,318,438	4,667,040
Oregon	37,052	2,812		7,559	10,371	47,423
Pennsylvania	2,720,672	213,757	382,418	1,906,309	2,502,484	5,223,156
South Carolina	142,021	6,045		46,250	52,295	194,316
Tennessee	539,158	39,057	8,920	163,262	211,239	750,397
Texas	211,962	13,838		60,895	74,733	286,695
Virginia	428,759	18,119	134,895	98,387	823,440	1,356,462
West Virginia	104,263	79,030		493,009		
Wisconsin	1,485,739	117,441	98,625	898,949	1,115,015	2,600,754
Total	32,090,998	2,114,421	2,259,191	14,693,126	19,066,738	51,157,736

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, and in 1904, $2,114,421. 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. In 1904 the imports were valued at

$7,146,871, duty $1,578,647, a total of $8,725,518. A conservative estimate would place the total value of these products in the wholesale markets of this country at $12,000,000 in both 1903 and 1904.

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	201,980	Free.	1,023,425	Free.	812,884	Free.	3,163,182	790,796
1898	28,688	$6,794	886,349	Free.	1,087,704	Free.	3,723,288	1,098,532
1899	57,192	18,536	700,786	Free.	743,130	Free.	3,900,099	1,170,030
1900	89,175	24,069	771,336	Free.	537,812	Free.	4,792,103	1,437,631
1901	76,786	22,227	713,392	Free.	589,535	Free.	4,034,171	1,210,251
1902	57,852	21,913	1,028,327	Free.	631,467	Free.	4,911,668	1,473,500
1903	19,012	7,827	660,464	Free.	789,553	Free.	5,252,611	1,575,783
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 most important events bearing upon the production, sale, and export of petroleum in the United States during the year 1904 are as follows:

(1) The production was greater than that of any previous year, the quantity having increased two and one-third times in ten years.

(2) There was a continuance of the remarkable increase in the production of an inferior grade of petroleum in California, Texas, and Louisiana, and of the increase in Kansas and Indian Territory of a fair grade of petroleum.

(3) For the first time in the history of the petroleum industry the quantity produced west of the Mississippi River was greater than that produced east.

(4) There were new fields of petroleum developed in Texas, California, and Kansas in 1904.

(5) The regularity of the sum of the production of the older fields for a series of years continued to be remarkable.

(6) The general average price or value of the entire production was less in 1904 than in the preceding year, while that of the output of the eastern fields was greater.

(7) There was an increase in the stocks of petroleum held in the Appalachian field and a slight decline in the Lima-Indiana field, and an increase in stocks held in Kansas, Texas, Louisiana, and California.

(8) There was an increase in the demand for refined petroleum throughout the United States, especially for the lighter grades used in internal-combustion engines of motors. There was an increased quantity of the heavier crude petroleum produced in Louisiana, Texas, and California consumed as fuel.

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[a] Credit should be given for much of the statistical information as to the United States in this report to the Oil City Derrick, and to Miss Belle Hill, 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.

(9) There was a slight increase in the quantity and value of the exports of petroleum and its products in 1904 as compared with the preceding year.

INCREASE IN THE PRODUCTION IN THE UNITED STATES.

The total production of crude petroleum in the United States in 1904 was 117,063,421 barrels, being much larger than any previous year and greater than that of 1903 by 16,602,084 barrels, a gain of 16.53 per cent as compared with a gain of 13.17 per cent in 1903 over 1902. The largest increases came from California, Texas, Kansas, Indiana, and Louisiana. The largest decrease was in Ohio. California produced 25.33 per cent of the whole; Texas, 19 per cent; and Kansas, Indian Territory and Oklahoma, Colorado, and Louisiana supplied 7.74 per cent. Their sum amounts to about 52 per cent, which is the percentage produced west of the Mississippi River in 1904, as compared with 44.62 per cent in 1903. Of the important producing States Kansas alone increased 356 per cent; Texas, 23.87 per cent; Indiana, 23.43 per cent; California, 21.60 per cent; and Louisiana, 220.5 per cent. Of the smaller producing States and Territories, Indian Territory and Oklahoma increased 883.9 per cent; Kentucky and Tennessee, 80.1 per cent.

On the other hand, there was a decrease in the production in New York of 19.32 per cent, in Ohio of 7.83 per cent, in West Virginia of 1.97 per cent, and in Pennsylvania of slightly less than one-half of 1 per cent. Much the largest decrease, when quantity is considered, occurred in Ohio.

PERCENTAGE OF PRODUCTION BY FIELDS.

The following table reveals the fact that during the last seven years there has been a remarkable change in the localities producing petroleum. For many years the Appalachian and the Lima-Indiana fields alone produced almost the entire quantity of petroleum in the United States. All the other fields in 1898 produced but 6.01 per cent, in 1899 but 6.62 per cent, and in 1900 but 8.75 per cent of the total output. In 1901, owing to the large increase in the production in California and Texas, the percentage of production in the States west of the Mississippi was increased to within a small fraction of 20 per cent of the total; in 1902 it was 37.62 per cent; in 1903 it was 44.62 per cent; and in 1904 the output of the newer western fields amounted to a little over 52 per cent of the entire production, which increase was due chiefly to the gain in production in Kansas, Indian Territory and Oklahoma, and Louisiana.

To provide for the storage, transportation, and marketing of this constantly increasing production required an immense outlay in building pipe lines, tanks, tank cars, and tank vessels.

When the value of the petroleum is considered, it will be found that in 1904 the 48 per cent of the entire output of the United States produced east of the Mississippi sold for 76.7 per cent of the total value of the production, so that it took 3.6 barrels of western petroleum to equal in value one barrel of eastern oil. The greater portion of the western production is consumed as fuel in competition with bituminous coal. On the other hand, the Appalachian and the Lima-Indiana production produces the higher grades of refined products.

Percentages of total crude petroleum produced in the several fields, 1898–1904.

Field.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Appalachian	57.29	57.94	57.05	48.45	36.07	31.41	26.83
California	4.08	4.63	6.79	12.66	15.75	24.27	25.33
Lima-Indiana	36.70	35.44	34.20	31.61	26.31	23.97	21.09
Texas	.98	1.17	1.31	6.33	20.37	17.87	19.00
All other	.95	.82	.65	.95	1.50	2.48	7.75
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

DECREASE IN PRICE AND INCREASE IN TOTAL VALUE.

The total value of all the petroleum marketed in the United States during 1904 was $101,170,466, a gain of $6,476,416 over 1903, and the largest value hitherto recorded. The average price received was 86.4 cents per barrel as compared with 94.26 cents for 1903; there was therefore a decline of 7.86 cents per barrel, which was more than offset by the increase in quantity. There was a gain of 14.07 cents per barrel in value in 1903 over 1902.

Ohio still leads in the value of its production, although showing a considerable decline as compared with 1903. West Virginia and Pennsylvania have almost exactly the same value as for the preceding year. Indiana shows a large gain in value, owing to the increased production. Since 1901 the increase in the production of the cheaper grades of petroleum has influenced the average price per barrel notwithstanding that for several years the price of eastern petroleum has been higher.

The average price paid for Pennsylvania petroleum during 1904 was $1.62¾ per barrel. Under this term is included nearly all of the production in New York, Pennsylvania, West Virginia, Kentucky, and southeastern Ohio. The average price for Pennsylvania petroleum in 1903 was $1.59 per barrel, which was 3¾ cents per barrel less than the average for 1904. There was a gain in 1903 of 35¼ cents per barrel for this grade of petroleum as compared with the price in 1902.

The price of Lima-Indiana petroleum decreased about 6.2 cents per barrel in 1904 as compared with 1903, although there was an increase of 27 cents in 1903 as compared with 1902.

The average value of California petroleum showed a decline of 2.4 cents per barrel in 1904 as compared with 1903; Texas petroleum a decrease of 5.2 cents per barrel in 1904 as compared with 1903, and the value of the petroleum production in Kansas, Indian Territory, and Oklahoma declined 8.7 cents per barrel in 1904 as compared with 1903. The price of Louisiana petroleum declined about 9 cents per barrel in 1904 as compared with 1903, but even at these figures there remained unsold in the tanks of the producers at the close of the year 3,670,000 barrels, and this quantity could not therefore be taken into the statement as there had been no value determined for it up to the close of 1904.

NEW POOLS DISCOVERED.

There were several new pools discovered during 1904 in Texas, California, Kansas, Indian Territory, and Oklahoma, and many extensions were made to the old ones. In fact, an immense section, beginning in southeastern Kansas and extending southwest into northern Indian Territory and Oklahoma, now over 180 miles in length and 50 miles in width, was proved to be locally productive of petroleum and natural gas. The possibilities in this great area and its effect on the general market of the higher grades of petroleum is one of the problems of the future.

In Texas the Humble field was being developed at the close of 1904, with indications of comparatively a large area of prolific territory.

California has added a number of new localities in which large wells have been developed. Louisiana also largely increased its productive territory during 1904, not so much by locating new territory as by the successful development of known areas. All indications point to an increase in the production of petroleum in the United States for a series of years. The larger proportion of the petroleum produced in the localities noted is of an inferior quality so far as producing the higher grades of refined products, except in limited quantity, is concerned, yet its high heating value and the absence of the more volatile constituents render it comparatively safe to transport and consume, and have contributed to make it a most valuable fuel. It is especially acceptable as such in California, Texas, and Louisiana, where the coal supply is insufficient.

INCREASE IN EXPORTS.

The export of petroleum and its derivatives during 1904 was 1,022,116,276 United States gallons, valued at $80,624,207, an average of 7.89 cents per gallon, as compared with 936,697,255 gallons, valued at $72,628,539, in 1903. The gross quantity in 1904 was slightly exceeded in 1901 and 1902; the value, however, is the largest in the history of the export of petroleum, and is second in the list of domestic mineral exports in 1904, being surpassed in value only by iron and steel manufactured goods. The port of New York handled 50 per cent, Philadelphia and ports on the Delaware 38½ per cent. Galveston, Tex., which includes Port Arthur and Sabine Pass, exported about 4 per cent. The quantity of petroleum and its products exported from these last-mentioned ports in 1904 was almost double that of 1903, while the value increased nearly four times, showing that these ports are rapidly growing in importance. There was also 7½ per cent exported from other districts.

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 1903 and 1904, by States and important districts:

Total quantity and value of crude petroleum produced in the United States and the average price per barrel in 1903 and 1904.

[Barrels.]

State and district.	1903.			1904.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
California	24,382,472	$7,399,349	$0.303	29,649,434	$8,265,434	$0.279
Colorado	483,925	431,723	.892	501,763	578,035	1.152
Indiana	9,186,411	10,474,127	1.14	11,339,124	12,235,674	1.079
Indian Territory, Oklahoma	138,911	142,402	1.025	1,366,748	5,447,622 (Indian Territory, Oklahoma, and Kansas)	.970
Kansas	932,214	988,220	1.06	4,250,779		
Kentucky, Tennessee	554,286	486,083	.877	998,284	984,938	.9866
Louisiana	917,771	416,228	.4535	[a]2,941,419	1,068,605	.3633
Michigan, Missouri	3,000	4,650	1.55	2,572	4,769	1.854
New York	1,162,978	1,849,135	1.59	938,234	1,526,976	1.6275
Ohio:						
Eastern and southern	5,585,858	8,881,514	1.59	5,526,146	8,993,803	1.6275
Lima	14,893,853	17,351,339	1.165	13,350,060	14,735,129	1.10375
Mecca-Belden	575	1,668	2.90	425	1,583	3.725
Total	20,480,286	26,234,521	1.28	18,876,631	23,730,515	1.257
Pennsylvania:						
Franklin	48,209	192,836	4.00	48,499	193,996	4.00
Pennsylvania	11,305,692	17,976,050	1.59	11,251,183	18,311,300	1.6275
Smiths Ferry	1,255	1,995	1.59	1,110	1,807	1.6279
Total	11,355,156	18,170,881	1.60	11,300,792	18,507,103	1.6377
Texas	17,955,572	7,517,479	.4187	22,241,413	8,156,220	.367

[a] In addition to this quantity some 3,670,000 barrels were produced and unsold, remaining on hand at the close of 1904.

Total quantity and value of crude petroleum produced in the United States and the average price per barrel in 1904—Continued.

[Barrels.]

State and district.	1903.			1904.		
	Quantity.	Value.	Average price per barrel.	Quantity.	Value.	Average price per barrel.
West Virginia:						
West Virginia	12,893,079	$20,499,996	$1.59	12,636,253	$20,557,556	$1.6269
Petroleum / Volcano	[a] 6,316	16,536	2.62	[a] 8,433	26,225	3.11
Total	12,899,395	20,516,532	1.59	12,644,686	20,583,781	1.628
Wyoming	8,960	62,720	7.00	11,542	80,794	7.00
Grand total	100,461,337	94,694,050	.9426	117,063,421	101,170,466	.864

[a] Production of light oil in Petroleum and in Volcano is included with West Virginia's production. Production of light oil in Volcano included with West Virginia's production.

The increase or decrease in the production by States, as well as the percentages of increase or decrease in 1904 compared with 1903, are shown in the following table:

Total production of crude petroleum and percentage of increase or decrease, by States, in 1904, as compared with 1903.

[Barrels.]

State.	Production.		Increase.	Decrease.	Percentage.	
	1903.	1904.			Increase.	Decrease.
California	24,382,472	29,649,434	5,266,962	....	21.60	....
Colorado	483,925	501,763	17,838	....	3.686	....
Indiana	9,186,411	11,339,124	2,152,713	....	23.43	....
Indian Territory / Oklahoma	138,911	1,366,748	1,227,837	....	883.9	....
Kansas	932,214	4,250,779	3,318,565	....	355.99	....
Kentucky / Tennessee	554,286	998,284	443,998	....	80.10	....
Louisiana	917,771	2,941,419	2,023,648	....	220.5	....
Michigan / Missouri	3,000	2,572	....	428	....	14.27
New York	1,162,978	938,234	....	224,744	....	19.32
Ohio	20,480,286	18,876,631	....	1,603,655	....	7.83
Pennsylvania	11,355,156	11,300,792	....	54,364	....	.479
Texas	17,955,572	22,241,413	4,285,841	....	23.87	....
West Virginia	12,899,395	12,644,686	....	254,709	....	1.97
Wyoming	8,960	11,542	2,582	....	28.82	....
Total	100,461,337	117,063,421	16,602,084	....	16.525	....

RANK OF STATES.

The following tables show the order of production of the several States of the United States, the quantity produced by each, and their percentages of the whole in 1903 and 1904:

Rank of petroleum-producing States and Territories, with quantity produced and percentage of each in 1903 and 1904.

[Barrels.]

State.	1903. Rank.	1903. Quantity.	1903. Percentage.	State.	1904. Rank.	1904. Quantity.	1904. Percentage.
California	1	24,382,472	24.27	California	1	29,649,434	25.33
Ohio	2	20,480,286	20.39	Texas	2	22,241,413	19.00
Texas	3	17,955,572	17.87	Ohio	3	18,876,631	16.13
West Virginia	4	12,899,395	12.84	West Virginia	4	12,644,686	10.80
Pennsylvania	5	11,355,156	11.30	Indiana	5	11,339,124	9.69
Indiana	6	9,186,411	9.14	Pennsylvania	6	11,300,792	9.65
New York	7	1,162,978	1.16	Kansas	7	4,250,779	3.63
Kansas	8	932,214	.93	Louisiana	8	2,941,419	2.51
Louisiana	9	917,771	.92	Indian Territory / Oklahoma	9	1,366,748	1.17
Kentucky / Tennessee	10	554,286	.55	Kentucky / Tennessee	10	998,284	.85
Colorado	11	483,925	.48	New York	11	938,234	.80
Indian Territory / Oklahoma	12	138,911	.15	Colorado	12	501,763	.43
Wyoming	13	8,960		Wyoming	13	11,542	.01
Michigan / Missouri	14	3,000		Michigan / Missouri	14	2,572	
Total		100,461,337	100.00	Total		117,063,421	100.00

California produced over one-quarter of the entire output of the United States in 1904, an increase of 1 per cent over the production of 1903, and maintained its place at the head of the column of oil-producing States.

During 1904 Texas replaced Ohio as second in rank. West Virginia maintained her position. Indiana produced more petroleum by a few barrels than did Pennsylvania. Kansas now occupies the rank formerly held by New York. The latter is now also surpassed in production by Louisiana, by Indian Territory and Oklahoma, and by Kentucky and Tennessee.

When the States are arranged according to the value of the production instead of the quantity produced, as in the preceding table, there is an entire readjustment. Ohio heads the list in the latter table, and California, at the head of the former list, is retired to the fifth place. Ohio, West Virginia, Pennsylvania, and Indiana have for several years maintained their places at the head of the list when rank in value is discussed.

Rank of petroleum-producing States and Territories, with value of production and percentage of each, in 1903 and 1904.

1903.				1904.			
State.	Rank.	Value.	Percentage.	State.	Rank.	Value.	Percentage.
Ohio	1	$26,234,521	27.71	Ohio	1	$23,730,515	23.46
West Virginia	2	20,516,532	21.67	West Virginia	2	20,583,781	20.35
Pennsylvania	3	18,170,881	19.19	Pennsylvania	3	18,507,103	18.29
Indiana	4	10,474,127	11.06	Indiana	4	12,235,674	12.09
Texas	5	7,517,479	7.94	California	5	8,265,434	8.17
California	6	7,399,349	7.81	Texas	6	8,156,220	8.06
New York	7	1,849,135	1.95	Kansas	7	5,447,622	5.39
Kansas	8	988,220	1.04	Indian Territory			
Kentucky	9	486,083	.51	Oklahoma			
Tennessee				New York	8	1,526,976	1.51
Colorado	10	431,723	.46	Louisiana	9	1,068,605	1.06
Louisiana	11	416,228	.44	Kentucky	10	984,938	.97
Indian Territory	12	142,402	.15	Tennessee			
Oklahoma				Colorado	11	578,035	.57
Wyoming	13	62,720	.07	Wyoming	12	80,794	.08
Michigan	14	4,650		Michigan	13	4,769	
Missouri				Missouri			
Total	......	94,694,050	100.00	Total	......	101,170,466	100.00

PRODUCTION BY FIELDS AND STATES.

The production of petroleum in the principal fields of the United States from 1899 to 1904, inclusive, was as follows:

Production of petroleum in the United States, 1899–1904, by fields and States.

[Barrels of 42 gallons.]

Field.	1899.	1900.	1901.	1902.	1903.	1904.
Appalachian	33,068,356	36,295,433	33,618,171	32,018,787	31,558,248	31,408,567
Lima-Indiana	20,225,356	21,758,750	21,933,379	23,358,626	24,080,264	24,689,184
California	2,642,095	4,324,484	8,786,330	13,984,268	24,382,472	29,649,434
Colorado	390,278	317,385	460,520	396,901	483,925	501,763
Kansas	69,700	74,714	179,151	331,749	932,214	4,250,779
Texas	669,013	836,039	4,393,658	18,083,658	17,955,572	22,241,413
Louisiana	....	....	....	548,617	917,771	[a] 2,941,419
Indian Territory and Oklahoma	....	....	....	37,100	138,911	1,366,748
Wyoming	5,560	5,450	5,400	6,253	8,960	11,542
Other	492	8,274	12,585	957	3,000	2,572
Total	[b] 57,070,850	[c] 63,620,529	69,389,194	88,766,916	100,461,337	117,063,421

[a] In addition to this quantity, 3,670,000 barrels were produced in Louisiana and unsold at close of 1904.
[b] In addition to this quantity 13,578 barrels were produced in Kentucky and Tennessee 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.

Previous to 1897 for a number of years the list of fields and States maintained their relative positions. In 1898 the State of Texas, owing to the new Corsicana field, increased much more rapidly than did the other States. In 1901 there was a most remarkable increase in Texas and California. Since 1903 the production in California has exceeded that of the Lima-Indiana field.

It will be noticed that the total production for 1904 is more than double that of 1899.

COMBINED VALUES OF PETROLEUM AND NATURAL GAS IN 1904.

The combined value of petroleum and natural gas, which ranks next to the values of pig iron and coal in the list of values of the crude mineral products of the United States in 1904, is shown in the following table:

Value of petroleum and of natural gas produced in 1904, their combined value and percentage, and rank of combined value, by States.

State.	Rank.	Value of crude petroleum.	Value of natural gas.	Value of petroleum and natural gas.	Percentage.
Pennsylvania	1	$18,507,103	$18,139,914	$36,647,017	26.24
Ohio	2	23,730,515	5,315,564	29,046,079	20.80
West Virginia	3	20,583,781	8,114,249	28,698,030	20.55
Indiana	4	12,235,674	4,342,409	16,578,083	11.87
California	5	8,265,434	114,195	8,379,629	6.00
Alabama and Texas	6	8,156,220	14,082	8,170,302	5.85
Kansas, Indian Territory, Oklahoma	7	5,447,622	1,567,308	7,014,930	5.02
New York	8	1,526,976	522,575	2,049,551	1.47
Kentucky and Tennessee	9	984,938	322,404	1,307,342	.94
Louisiana	10	1,068,605		1,068,605	.76
Colorado	11	578,035	14,300	592,335	.42
Arkansas and Wyoming	12	80,794	6,515	87,309	.08
South Dakota	13		12,215	12,215	
Michigan and Missouri	14	4,769	6,285	11,054	
Illinois	15		4,745	4,745	
Total		101,170,466	38,496,760	139,667,226	100.00

PRODUCTION OF CRUDE PETROLEUM IN THE UNITED STATES FROM 1859 TO 1904, 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 1904, the table being by years and States:

Production of crude petroleum in the United States, 1859–1904, 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
1904	12,239,026	18,876,631	12,644,686	29,649,434	998,284	501,763	11,339,124
Total	653,158,616	323,108,234	157,245,377	95,866,379	2,185,782	7,838,614	66,361,750

[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, 1859–1904, 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	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
1904	....	4,250,779	22,241,413	d 2,572	f 1,366,748	11,542	g 2,941,419	117,063,421
Total	6,576	6,210,486	64,793,209	10,871	1,560,313	60,992	4,407,807	1,382,815,006

a In addition to this quantity, it is estimated that for want of a market some 10,000,000 barrels ran to waste in and prior to 1862 in the Pennsylvania fields; also a large quantity in West Virginia and Tennessee.
b Includes all production prior to 1876 in Ohio, West Virginia, and California.
c In addition to this quantity, 4,325 barrels of crude oil were produced in Kentucky and Tennessee in 1896, 4,377 barrels in 1897, 19,125 barrels in 1898, and 13,578 barrels in 1899, for which, as none was sold or used, no value could be given.
d Includes the production of Michigan.
e Includes production of Michigan and small production in Oklahoma Territory.
f Includes production of Oklahoma.
g In addition to this quantity, about 3,670,000 barrels were produced and unsold in 1904.

The entire production in the United States since petroleum was first discovered in large quantities in 1859 up to the close of 1904 amounted to 1,382,815,006 barrels, which sold for $1,363,069,897, an average price of 98.6 cents per barrel.

The fluctuations in average price and production are more fully illustrated in the accompanying chart, in which the barrels produced and the value in dollars are both plotted to a horizontal scale of 25,000,000 to 1 inch. If we allow 5.6 cubic feet to 1 barrel the quantity would equal 7,743,764,033 cubic feet, which would require a cube whose sides would measure 1,978 feet to contain it. It would fill a tank whose base was 1 square mile to a height of 277 feet. If we consider that 3½ barrels of petroleum are equal to the heating power of 1 ton of average coal, it would be the equivalent to 395,090,002 tons of coal. Of this grand total up to the close of 1904, Pennsylvania and New York produced 47.2 per cent, Ohio 23.4 per cent, West Virginia 11.4 per cent, California 6.9 per cent, Indiana 4.8 per cent, and Texas 4.7 per cent, leaving 1.6 per cent to be made up by the remaining States and Territories.

DECREASE IN THE APPALACHIAN FIELD.

There was a slight decrease in the Appalachian oil field in 1904, amounting to less than one-half of 1 per cent, as compared with 1903. All of the field showed a reduced production, by States, except Kentucky and Tennessee, which showed a gain of 443,998 barrels.

It is this field that produces the superior quality of petroleum known as "Pennsylvania oil," which is the standard of quality the world over, because of the large yield and superior quality of the illuminating and lubricating products secured.

The following table gives the production of the Appalachian States in 1903 and 1904, with the percentages 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 1903 and 1904, by States, showing increase or decrease.

[Barrels.]

State.	Quantity.		Increase.	Decrease.	Percentage.	
	1903.	1904.			Increase.	Decrease.
New York	1,162,978	938,234		224,744		19.32
Pennsylvania	11,355,156	11,300,792		54,364		.478
West Virginia	12,899,395	12,644,686		254,709		1.97
Southeastern Ohio	5,586,433	5,526,571		59,862		1.07
Kentucky and Tennessee	554,286	998,284	443,998		80.10	
Total	31,558,248	31,408,567		149,681		.474

U. S. G

YEAR

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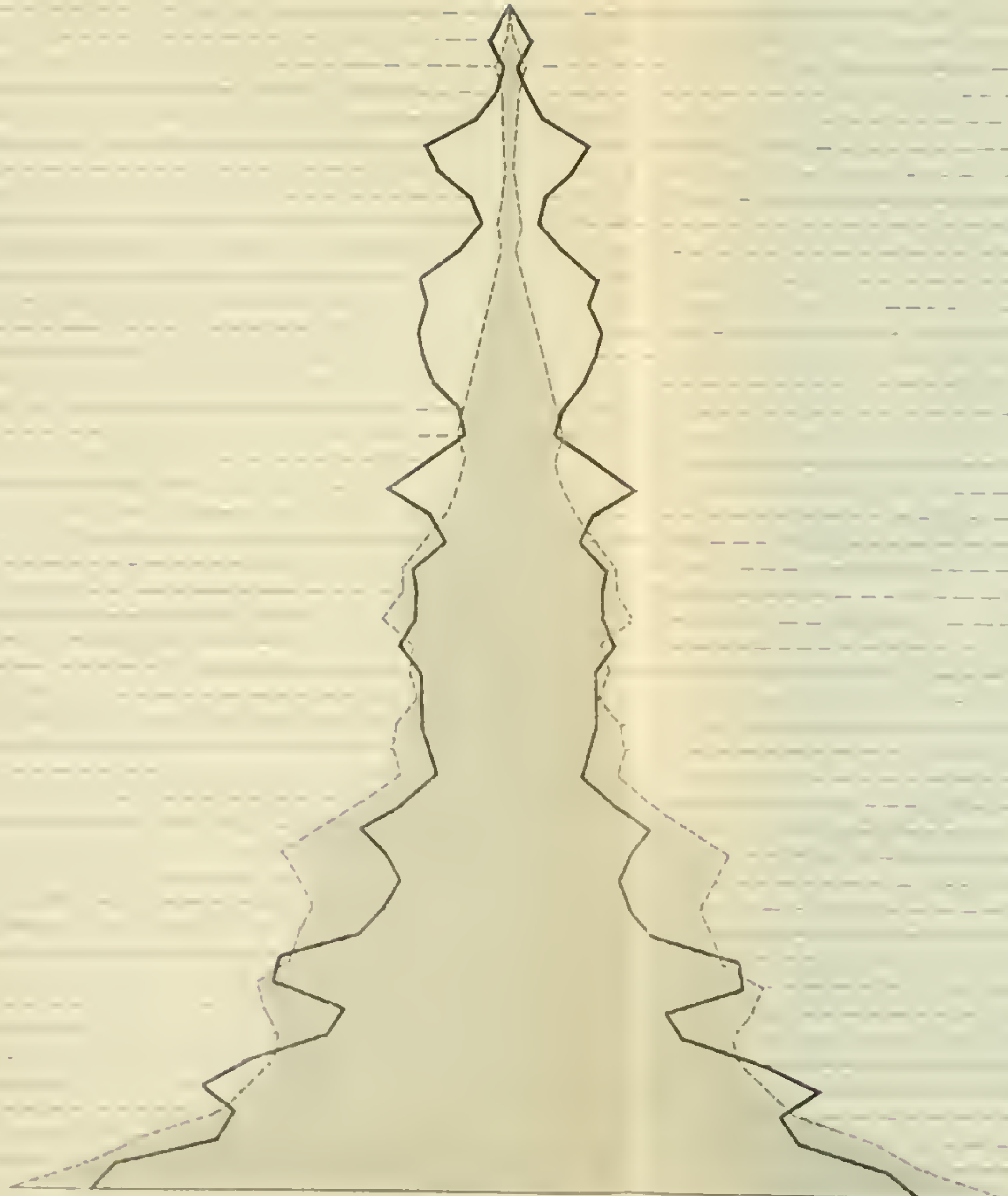

YEAR.	VALUE.	BARRELS (42 gallons).	YEAR.
1859	$32,000	2,000	1859
1860	4,800,000	500,000	1860
1861	1,035,668	2,113,609	1861
1862	3,209,525	3,056,690	1862
1863	8,225,663	2,611,309	1863
1864	20,896,576	2,116,109	1864
1865	16,459,853	2,497,700	1865
1866	13,455,398	3,597,700	1866
1867	8,066,993	3,347,300	1867
1868	13,217,174	3,646,117	1868
1869	23,730,450	4,215,000	1869
1870	20,503,754	5,260,745	1870
1871	22,591,180	5,205,234	1871
1872	21,440,503	6,293,194	1872
1873	18,100,464	9,893,786	1873
1874	12,647,527	10,926,945	1874
1875	11,863,133	12,162,514	1875
1876	22,982,822	9,132,669	1876
1877	31,788,566	13,350,363	1877
1878	18,044,520	15,396,868	1878
1879	17,210,708	19,914,146	1879
1880	24,600,638	26,286,123	1880
1881	23,512,051	27,661,238	1881
1882	23,759,911	30,510,830	1882
1883	25,740,252	23,449,663	1883
1884	20,476,924	24,218,438	1884
1885	19,193,694	21,858,785	1885
1886	20,028,457	28,064,841	1886
1887	18,856,606	28,283,483	1887
1888	17,950,353	27,612,025	1888
1889	26,963,340	35,163,513	1889
1890	35,365,105	45,823,572	1890
1891	30,526,553	54,292,655	1891
1892	25,901,463	50,509,657	1892
1893	28,932,326	48,431,066	1893
1894	35,522,095	49,344,516	1894
1895	57,691,279	52,892,276	1895
1896	58,518,709	60,960,361	1896
1897	40,929,611	60,475,516	1897
1898	44,193,359	55,364,233	1898
1899	64,603,904	57,070,850	1899
1900	75,752,691	63,620,529	1900
1901	66,417,335	69,389,184	1901
1902	71,178,910	88,766,916	1902
1903	94,694,050	100,461,337	1903
1904	101,170,466	117,063,421	1904
Total.	1,362,781,879	1,382,815,006	

Scale:
25,000,000 barrels = 1 inch.
25,000,000 dollars = 1 inch.

Explanation:
- - - - - - - - - - production line
———————— value line

CHART SHOWING PRODUCTION AND VALUE OF PETROLEUM FROM 1859 TO 1904.

INCREASE IN THE LIMA-INDIANA FIELD.

This is a comparatively new field, and includes a portion of northwestern Ohio and central Indiana, in which the Trenton limestone alone is productive. The petroleum carries a percentage of sulphureted hydrogen in its composition, which renders its odor particularly offensive. This odor is now entirely removed by improved methods of distillation. For several years past there has been a gradual decline in the production of this field in Ohio, which has been more than offset by the increase in the yield of the Indiana division. The increase in this field in 1904 over 1903 was 608,920 barrels, amounting to 2.53 per cent. The combined production of the Appalachian and the Lima-Indiana fields has continued remarkably regular for a series of years, the decline in the former being offset by the gain in the latter.

Production of petroleum in the Lima-Indiana field in 1903 and 1904.

[Barrels.]

State.	Quantity.		Increase.	Decrease.	Percentage.	
	1903.	1904.			Increase.	Decrease.
Ohio	14,893,853	13,350,060		1,543,793		10.36+
Indiana	9,186,411	11,339,124	2,152,713		23.43	
Total	24,080,264	24,689,184	608,920		2.53−	

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 1903 and 1904:

Number of wells completed and of dry holes in the Appalachian and Lima-Indiana fields in 1903 and 1904, by months.

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

Number of wells completed and of dry holes in the Appalachian and Lima-Indiana fields in 1903 and 1904, by months—Continued.

1904.

Month.	Appalachian.		Lima-Indiana.		Total both fields.	
	Completed.	Dry.	Completed.	Dry.	Completed.	Dry.
January	547	158	557	35	1,104	193
February	504	148	343	30	847	178
March	595	170	488	38	1,083	208
April	743	203	455	41	1,198	244
May	770	185	548	76	1,318	261
June	893	244	717	74	1,610	318
July	851	204	683	68	1,534	272
August	862	231	733	68	1,595	299
September	868	211	651	44	1,519	255
October	802	260	631	55	1,433	315
November	819	203	529	42	1,348	245
December	605	166	562	52	1,167	218
Total	8,859	2,383	6,897	623	15,756	3,006

Stocks of petroleum held by pipe lines at close of 1900, 1901, 1902, 1903, and 1904 in the Appalachian and Lima-Indiana fields.

[Barrels of 42 gallons.]

	1900.	1901.	1902.	1903.	1904.
National Transit Co	8,174,506	5,069,782	1,456,556	1,037,458	2,394,225
Southwest Pennsylvania Pipe Line Co	1,368,892	865,477	505,270	706,769	644,358
Eureka Pipe Line Co	1,401,201	1,465,606	1,440,810	1,009,472	1,205,216
Buckeye Pipe Line Co. (Macksburg oil)	591,899	476,491	606,492	472,150	344,147
Cumberland Pipe Line Co	....	128,574	279,493	408,378	321,866
Southern Pipe Line Co	471,599	391,892	326,448	429,547	521,076
Crescent Pipe Line Co	103,808	126,052	87,822	154,177	122,575
New York Transit Co	533,030	330,666	184,804	7,504	38,900
Tidewater Pipe Co	334,308	345,643	418,504	287,782	342,448
Producers and Refiners' Oil Co	148,769	139,868	283,154	241,987	327,589
Elk Oil Co	595	628	2,093	....	....
Emery Pipe Line Co	20,252	22,470	25,483	14,128	11,947
United States Pipe Line Co	25,857	57,271	82,198	53,847	81,166
Other lines	300,832	215,072	42,497	31,516	40,086
Total stocks, Appalachian field	13,475,548	9,635,492	5,741,624	4,854,715	6,395,599
Total Lima-Indiana stocks	14,988,928	17,760,306	17,306,426	15,138,637	14,856,398
Total both fields	28,464,476	27,395,798	23,048,050	19,993,352	21,251,997

This table shows that the stocks held in iron tanks by the pipe lines in the eastern fields at the close of 1904 were 21,251,997 barrels, a gain of 1,258,645 barrels during the year. While an increase of 1,540,884 barrels was recorded in the stocks at the close of 1904 in the Appalachian field, there was a decrease of 282,239 barrels in the Lima-Indiana field.

At the close of 1903 there was a decrease of 3,054,698 barrels in both fields as compared with the stocks held at the close of 1902.

Stocks have been gradually declining since 1900, and the decrease was heaviest in the Appalachian stocks until in 1904 there was an increase of over one and a half million barrels.

When the Bradford and Butler county fields were at their zenith in the early eighties the stocks of surplus petroleum in iron tanks rose to 40,000,000 barrels. This was before the discovery of the Lima-Indiana field.

WELL RECORD.

The estimated total number of wells drilled in the United States in 1904 was 19,777. Of this number 3,835 were dry or unproductive of petroleum in paying quantities, leaving 15,942 productive wells. At an average cost of $1,400 per well, the total number represents an investment of $27,687,800. The total number of wells drilled in the Appalachian and the Lima-Indiana fields in 1904 was 15,756, of which number 3,006 were dry, leaving 12,750 productive wells. The remaining 3,192 productive wells in 1904 were drilled west of the Mississippi River.

The proportion of productive wells to dry holes drilled in the United States during 1904 was as 81 is to 19.

Wells completed in 1904.

	Wells.		
	Total.	Productive.	Dry.
Appalachian / Lima-Indiana	15,756	12,750	3,006
Kansas, Indian Territory, and Oklahoma	3,075	2,600	475
Texas	440	264	176
Louisiana	23	13	10
Colorado and Wyoming	25	15	10
California	458	300	158
Total	19,777	15,942	3,835

STOCKS HELD.

The estimated stocks held in the United States at the close of 1904 were as follows:

	Barrels.
Appalachian field	6,395,599
Lima-Indiana	14,856,398
Kansas, Oklahoma, and Indian Territory	5,850,000
Louisiana	5,750,000
Texas	13,352,920
Colorado and Wyoming	275,000
California	10,850,000
Total	57,329,917

IMPORTS.

The following table, prepared by the Bureau of Statistics of the Department of Commerce and Labor, shows the imports of refined petroleum products in the calendar year 1904, by customs districts and by countries:

Imports of mineral oil into the United States in 1904, by customs districts and by countries.

[Gallons.]

	Free of duty.		Dutiable.	
	Quantity.	Value.	Quantity.	Value.
CUSTOMS DISTRICT.				
Baltimore	31,223	$1,191	50,328	$8,563
Bangor	547	40	142	17
Boston	283,264	16,199		
Newport News	170,000	11,339		
New York	404,805	23,169	70,093	3,892
Norfolk and Portsmouth	50,000	3,042		
Philadelphia			467,625	18,878
Galveston	931,155	51,393		
Mobile	408,000	16,721		
New Orleans	1,238,750	69,989		
Puget Sound	437,752	38,485		
Buffalo Creek			83,580	4,107
Champlain	6,952	452		
Detroit	27,746	1,153		
Erie			15	5
Genesee			2,833	377
Huron	180,640	8,074		
Minnesota			1,093	247
Montana and Idaho			138	66
Total	4,170,834	241,247	675,847	36,152
COUNTRY.				
Austria-Hungary	2,160	201		
Belgium	100	32	65,065	4,861
France	100	8	32	24
Germany	220,256	4,289	29,915	5,709
Netherlands	16,000	1,866	467,625	18,878
Russia:				
Baltic Sea			45,566	2,179
Black Sea			55,925	2,795
United Kingdom	3,629,049	219,261	10,141	1,291
Nova Scotia, etc	115,577	7,064	107	10
Quebec, Ontario, etc	187,592	8,526	1,281	325
Japan			190	80
Total	4,170,834	241,247	675,847	36,152

EXPORTS.

The following tables are the official statement by the Bureau of Statistics of the Department of Commerce and Labor 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, 1904, as compared with the preceding year:

Exports of mineral oils from the United States in 1903 and 1904.

[Gallons.]

Port and kind.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
CRUDE.				
Boston and Charlestown	5,000	$450		
Delaware	94,260,271	5,280,778	61,733,773	$3,633,207
New York	6,542	406	768,659	78,696
Philadelphia	15,414,523	989,675	18,973,662	1,300,061
Galveston	12,298,357	260,440	14,498,551	728,568
Other districts	4,526,994	250,387	15,201,831	610,150
Total	126,511,687	6,782,136	111,176,476	6,350,682
NAPHTHA.				
Baltimore	1,800	361	1,083	222
Boston and Charlestown	630	104		
Delaware	33,547	3,083	169,373	15,401
New York	7,423,541	944,431	9,067,783	1,020,841
Philadelphia	4,205,068	425,572	13,599,108	1,058,753
Galveston				
Other districts	1,308,567	144,990	2,152,075	226,497
Total	12,973,153	1,518,541	24,989,422	2,321,714
ILLUMINATING.				
Baltimore	34,885,981	2,495,465	37,009,495	2,967,008
Boston and Charlestown	670,106	80,130	321,941	41,598
Delaware	130,927	11,950	766,426	43,079
New York	361,687,183	29,086,370	431,402,015	36,410,854
Philadelphia	270,212,278	18,058,258	258,027,732	16,765,552
Galveston	4,711,964	143,159	18,214,462	1,054,096
Other districts	19,538,795	1,480,336	15,616,084	1,102,086
Total	691,837,234	51,355,668	761,358,155	58,384,273
LUBRICATING AND PARAFFIN.				
Baltimore	2,314,770	267,246	2,226,308	280,479
Boston and Charlestown	104,635	18,621	121,682	20,143
Delaware			24,459	3,458
New York	66,429,994	9,591,421	61,728,992	9,195,701
Philadelphia	24,633,928	2,436,512	23,310,008	2,479,423
Galveston	30,563	3,555	28,033	3,214
Other districts	2,108,051	372,710	2,248,641	410,964
Total	95,621,941	12,690,065	89,688,123	12,393,382
RESIDUUM.				
Boston and Charlestown	27,090	1,562	540,288	29,546
New York	2,452,128	71,885	9,403,044	322,853
Philadelphia	2,497,320	59,988	16,267,952	527,538
Galveston	3,859,425	113,472	7,525,140	240,878
Other districts	917,277	35,222	1,167,676	53,341
Total	9,753,240	282,129	34,904,100	1,174,156
Grand total	936,697,255	72,628,539	1,022,116,276	80,624,207

Exports of mineral oils from the United States in 1903 and 1904—Continued.

RECAPITULATION BY KINDS.

[Gallons.]

	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
Crude petroleum	126,511,687	$6,782,150	111,176,476	$6,350,682
Naphtha	12,973,153	1,518,541	24,989,422	2,321,714
Illuminating oil	691,837,234	51,355,668	761,358,155	58,384,273
Lubricating oil and paraffin	95,621,941	12,690,051	89,688,123	12,393,382
Residuum	9,753,240	282,129	34,904,100	1,174,156
Total	936,697,255	72,628,539	1,022,116,276	80,624,207

RECAPITULATION BY PORTS.

Baltimore	37,202,551	$2,763,072	39,236,886	$3,247,709
Boston and Charlestown	807,461	100,867	983,911	91,287
Delaware	94,424,745	5,295,811	62,694,031	3,695,145
New York	437,999,388	39,694,513	512,370,493	47,028,945
Philadelphia	316,963,117	21,970,005	330,178,462	22,131,327
Galveston	20,900,309	520,626	40,266,186	2,026,756
Other districts	28,399,684	2,283,645	36,386,307	2,403,038
Grand total	936,697,255	72,628,539	1,022,116,276	80,624,207

Exports of mineral oils from the United States, 1887–1904.

[Gallons.]

Year.	Crude.	Naphtha.	Illuminating.	Lubricating and paraffin.	Residuum.	Total.	
						Quantity.	Value.
1887	80,643,839	12,344,669	464,702,903	20,340,820	2,989,098	581,021,329	$45,231,988
1888	77,387,799	13,466,234	450,801,683	24,280,826	1,861,104	567,797,646	47,563,749
1889	84,144,196	13,958,985	548,496,241	27,754,239	1,837,794	676,191,455	52,792,473
1890	95,368,525	12,406,586	547,542,569	31,896,146	1,828,900	689,042,726	51,657,302
1891	94,926,424	11,398,085	526,972,018	33,068,716	932,692	667,297,935	45,351,957
1892	104,012,829	16,351,340	586,406,366	33,805,128	329,574	740,905,237	42,283,163
1893	114,609,343	16,249,389	705,674,917	34,762,754	460,614	871,757,017	41,117,814
1894	114,268,611	14,831,967	726,726,687	38,975,128	59,766	894,862,159	40,463,088
1895	115,954,128	12,757,940	677,500,647	46,769,565	143,850	853,126,130	56,223,425
1896	117,921,276	13,420,769	749,305,844	50,629,143	507,990	931,785,022	62,764,278
1897	121,488,726	13,430,320	795,919,525	51,228,284	12,230,902	994,297,757	59,057,547
1898	114,915,082	17,026,626	761,152,107	63,968,341	29,418,454	986,480,610	52,551,048
1899	117,683,967	17,904,015	724,562,993	69,329,188	21,544,278	951,024,441	64,982,249
1900	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
1904	111,176,476	24,989,422	761,358,155	89,688,123	34,904,100	1,022,116,276	80,624,207

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 1901–1904, by months.

[Gallons.]

Month.	1901.		1902.	
January	86,664,193	$5,819,985	95,043,650	$6,064,804
February	65,538,129	4,539,727	66,481,793	4,390,794
March	75,197,239	5,417,085	88,483,621	5,512,559
April	87,932,625	6,251,802	88,970,138	5,775,468
May	98,677,736	6,576,904	90,324,733	6,048,791
June	85,156,212	5,538,986	96,997,150	5,869,983
July	99,415,209	6,373,491	86,633,444	5,662,837
August	93,502,384	6,268,383	89,853,637	5,563,917
September	102,177,175	6,738,977	82,268,037	4,953,792
October	91,267,756	6,464,608	100,990,406	6,557,263
November	95,652,943	6,296,115	83,554,869	5,485,884
December	97,892,918	6,498,849	94,632,123	6,711,051
Total	1,079,074,519	72,784,912	1,064,233,601	68,597,143

Month.	1903.		1904.	
January	59,728,465	$4,640,980	72,402,490	$6,062,725
February	70,957,459	5,128,788	72,252,357	6,273,253
March	63,709,151	4,822,125	69,799,388	5,988,037
April	78,776,378	6,157,035	98,666,653	7,563,027
May	78,194,996	5,987,375	70,826,501	5,601,540
June	74,659,397	5,582,486	89,805,969	7,262,137
July	87,005,600	6,336,286	101,065,644	7,345,360
August	80,412,826	5,949,247	89,766,640	6,846,683
September	87,935,631	6,574,333	94,281,924	7,558,818
October	84,675,226	7,052,394	94,827,182	7,518,950
November	82,715,599	6,756,802	91,615,860	6,731,136
December	87,926,527	7,640,688	76,805,668	5,872,541
Total	936,697,255	72,628,539	1,022,116,276	80,624,207

The preceding table indicates the remarkably steady trade in our exportation of petroleum and its derivatives over a series of years, and the gradual increase during the last four years The quantity exported in 1904 was only slightly exceeded in 1901 and 1902. The value for 1904 was never equaled, being about double the value of the exports in 1894. The table is conspicuous, because of the large increases in the quantity of naphtha exported and the handsome increase in the illuminating exportation. The large increase in residuum is due chiefly to the fuel petroleum exported from Texas, which has had the lighter products removed. The increase in value of the entire quantity exported in 1904 over 1903 was only a few dollars less than $8,000,000, as compared with the gain of about $4,000,000 in 1903 over 1902.

The following table exhibits the total production of crude petroleum from 1871 to 1904, 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 during that period:

Quantity of crude petroleum produced in, and quantities and values of petroleum produtsc exported from, the United States during each of the calendar years from 1871 to 1904, inclusive.

Year ending December 31—	Production.		Exports.			
			Mineral, crude (including all natural oils, without regard to gravity).		Mineral, refined or manufactured.	
					Naphtha, benzine, gasoline, etc.	
	Barrels (of 42 gallons).	Gallons.	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	15,676,421	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	5,141,833	12,382,213	1,049,043
1888	27,612,025	1,159,705,050	77,549,452	5,454,705	13,481,706	1,083,429
1889	35,163,513	1,476,867,546	85,189,658	6,134,002	13,984,407	1,208,116
1890	45,823,572	1,924,590,024	96,572,625	6,535,499	12,462,636	1,050,613
1891	54,292,655	2,280,291,510	96,722,807	5,365,579	11,424,993	868,137
1892	50,509,657	2,121,405,594	104,397,107	4,696,191	16,393,284	1,037,558
1893 [a]	48,431,066	2,034,104,772	111,703,508	4,567,391	17,304,005	1,074,710
1894 [a]	49,344,516	2,072,469,672	121,926,349	4,415,915	15,555,754	943,970
1895 [a]	52,892,276	2,221,475,592	111,285,264	5,161,710	14,801,224	910,988
1896 [a]	[b] 60,960,361	2,560,335,162	110,923,620	6,121,836	12,349,319	1,059,542
1897	[b] 60,475,516	2,539,971,672	121,488,726	5,020,968	13,430,320	994,781
1898	[b] 55,364,233	2,325,297,786	114,915,082	4,764,111	17,026,626	1,053,231
1899	[b] 57,070,850	2,396,975,700	117,683,967	5,957,829	17,904,015	1,557,607
1900 [c]	63,620,529	2,672,062,218	138,161,173	7,340,749	18,570,488	1,681,201
1901	69,389,194	2,914,346,148	127,008,002	6,037,544	21,684,734	1,741,547
1902	[d] 88,766,916	3,728,210,472	145,233,723	6,331,011	19,682,637	1,392,771
1903	100,461,337	4,219,376,154	126,511,687	6,782,136	12,973,153	1,518,541
1904	117,063,421	4,916,663,682	111,176,476	6,350,682	24,989,422	2,321,714

[a] Exports are for fiscal years from 1893 to 1896, inclusive.
[b] In addition to this quantity, 4,325 barrels of crude oil were produced in Kentucky and Tennessee in 1896, 4,377 barrels in 1897, 19,125 barrels in 1898, and 13,578 barrels in 1899, for which, as none was sold or used, no value could be given.
[c] Includes 41,405 barrels of oil sold in Kentucky and Tennessee in 1900, but produced in previous years.
[d] In addition to this quantity, 508,386 barrels were produced, but not marketed.

Quantity of crude petroleum produced in, and 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	$92,408
1872	118,259,832	29,456,453	438,425	180,462
1873	207,595,988	41,357,686	1,502,503	517,466
1874	206,562,977	30,168,747	993,068	269,886
1875	203,678,748	28,168,572	938,052	265,837
1876	220,831,608	44,089,066	1,157,929	370,431
1877	307,373,842	51,366,205	1,914,129	577,610
1878	306,212,506	36,855,798	2,525,545	698,182
1879	365,597,467	32,811,755	3,168,561	713,208
1880	286,131,557	29,047,908	5,607,009	1,141,825
1881	444,666,615	42,122,683	5,053,862	1,165,605
1882	428,424,581	37,635,981	8,821,536	2,034,487
1883	440,150,660	39,470,352	10,108,394	2,193,245
1884	433,851,275	39,450,794	11,985,219	2,443,385
1885	445,880,518	39,476,082	12,978,955	2,659,210
1886	485,120,680	39,012,922	13,948,367	2,689,464
1887	485,242,107	37,007,336	20,582,613	3,559,280
1888	455,045,784	37,236,111	24,510,437	4,215,449
1889	551,769,666	41,215,192	27,903,267	4,638,724
1890	550,873,438	39,826,086	32,090,537	4,766,850
1891	531,445,099	34,879,759	33,310,264	4,999,978
1892	589,418,185	31,826,545	34,026,855	5,130,643
1893 [a]	642,239,816	31,719,404	32,432,857	4,738,892
1894 [a]	730,368,626	30,676,217	40,190,577	5,449,000
1895 [a]	714,859,144	34,706,844	43,418,942	5,867,477
1896 [a]	716,455,565	48,630,920	50,525,530	6,556,775
1897	795,919,525	46,229,579	51,228,284	6,478,479
1898	761,152,107	38,542,082	63,968,341	7,385,054
1899	724,562,993	48,466,200	69,329,188	8,344,735
1900	739,163,464	54,692,872	71,211,353	9,933,548
1901	827,479,493	53,490,713	75,305,938	10,260,125
1902	778,800,978	49,079,055	82,200,503	10,872,154
1903	691,837,234	51,355,668	95,621,941	12,690,065
1904	761,358,155	58,384,273	89,688,123	12,393,382

[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	57,539,873
1878	3,126,816	220,835	349,346,253	41,022,007
1879	4,827,522	273,050	421,719,782	37,235,467
1880	3,177,630	198,983	346,779,443	34,505,645
1881	3,756,018	197,321	514,561,719	48,556,103
1882	4,265,352	275,263	503,492,462	44,623,074
1883	6,502,524	465,350	533,145,429	47,763,079
1884	5,303,298	327,599	544,495,608	49,457,116
1885	5,713,908	334,767	560,784,459	49,671,743
1886	1,993,824	109,673	591,884,302	48,145,204
1887	2,989,098	141,350	601,846,317	46,898,842
1888	1,870,596	116,009	572,457,975	48,105,703
1889	1,858,458	97,265	680,705,456	53,293,299
1890	1,830,612	91,905	693,829,848	52,270,953
1891	1,002,414	61,382	673,905,577	46,174,835
1892	403,032	38,220	744,638,463	42,729,157
1893 [a]	541,044	41,661	804,221,230	42,142,058
1894 [a]	211,008	14,704	908,252,314	41,499,806
1895 [a]	137,508	13,063	884,502,082	46,660,082
1896 [a]	204,960	14,330	890,458,994	62,383,403
1897	12,230,902	333,740	994,297,757	59,057,547
1898	29,418,454	806,570	986,480,610	52,551,048
1899	21,544,278	655,878	951,024,441	64,982,249
1900	19,749,996	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	72,628,539
1904	34,904,100	1,174,156	1,022,116,276	80,624,207

[a] Exports are for fiscal years from 1893 to 1896, inclusive.

PRODUCTION OF APPALACHIAN FIELD.

Production of petroleum in the Appalachian oil field, 1889–1904, 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
1904	12,239,026	12,644,686	5,526,571	998,284	31,408,567

In the following table is given the production of crude petroleum in the Appalachian oil field from 1898 to 1904, by months:

Production of crude petroleum in the Appalachian oil field, 1898–1904, by months and years.

[Barrels of 42 gallons.]

Month.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	2,816,744	2,492,679	2,918,175	3,003,285	2,614,845	2,726,634	2,377,630
February	2,466,179	2,285,466	2,595,900	2,567,288	2,253,491	2,353,281	2,294,922
March	2,864,640	2,736,784	3,004,813	2,916,677	2,629,104	2,759,807	2,719,887
April	2,689,463	2,642,830	2,950,469	2,862,813	2,664,668	2,691,431	2,599,224
May	2,714,522	2,825,254	3,148,944	2,963,001	2,759,717	2,681,586	2,743,881
June	2,595,599	2,796,098	3,068,693	2,751,409	2,598,349	2,731,722	2,700,030
July	2,573,112	2,845,149	3,100,319	2,921,520	2,825,398	2,758,308	2,697,037
August	2,668,438	3,001,267	3,198,715	2,941,578	2,728,825	2,628,708	2,822,017
September	2,579,174	2,839,983	3,002,998	2,644,103	2,769,060	2,633,513	2,668,124
October	2,581,690	2,920,530	3,245,506	2,814,972	2,860,506	2,664,422	2,606,321
November	2,527,950	2,863,429	3,009,503	2,590,781	2,609,453	2,374,373	2,558,764
December	2,639,914	2,818,887	3,051,398	2,640,744	2,705,371	2,554,463	2,620,730
Total	31,717,425	33,068,356	36,295,433	33,618,171	32,018,787	31,558,248	31,408,567

In the following table is given the average daily production in the Appalachian oil field from 1898 to 1904, by months and years:

Average daily production of crude petroleum in the Appalachian oil field each month, 1898–1904, by months and years.

[Barrels of 42 gallons.]

Month.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	90,863	80,422	94,135	96,880	84,350	87,956	76,698
February	88,076	81,618	92,711	91,689	80,482	84,046	79,135
March	92,407	88,283	96,929	94,086	84,810	89,026	87,738
April	89,648	88,092	98,349	95,427	88,822	89,714	86,641
May	87,565	91,137	101,579	95,581	89,023	86,503	88,512
June	86,519	93,202	102,290	91,714	86,612	91,057	90,001
July	83,003	91,779	100,010	94,243	91,142	88,978	87,001
August	86,079	96,815	103,184	94,890	88,027	84,797	91,033
September	85,972	94,664	100,100	88,137	92,302	87,784	88,937
October	83,280	94,210	104,694	90,806	92,274	85,949	84,075
November	84,264	95,446	100,317	86,359	86,982	79,146	85,292
December	85,158	90,932	98,432	85,185	87,270	82,402	84,540
Average	86,897	90,598	99,440	92,105	87,723	86,461	85,816

Average monthly prices of Appalachian crude petroleum in 1903 and 1904.

[Per barrel of 42 gallons.]

Month.	1903.				1904.			
	Tiona, Pa.	Pennsylvania.	Corning, Ohio.	Newcastle, Ohio.	Tiona, Pa.	Pennsylvania.	Corning, Ohio.	Newcastle, Ohio.
January	$1.67½	$1.52½	$1.32½	$1.39½	$2.00	$1.85	$1.65	$1.72
February	1.65	1.50	1.30	1.37	1.97	1.82	1.62	1.69
March	1.65	1.50	1.30	1.37	1.87⅛	1.72⅛	1.52⅛	1.59⅛
April	1.66	1.51	1.31	1.38	1.80½	1.65½	1.45½	1.52½
May	1.66½	1.51½	1.31½	1.38½	1.77	1.62	1.42	1.49
June	1.65	1.50	1.30	1.37	1.73⅝	1.58⅝	1.38⅝	1.45⅝
July	1.67½	1.52½	1.32½	1.39½	1.67	1.52	1.32	1.39
August	1.71	1.56	1.36	1.43	1.65	1.50	1.30	1.37
September	1.72¼	1.57¼	1.37¼	1.41¼	1.68¾	1.53¾	1.33	1.40¾
October	1.83½	1.68½	1.48½	1.55½	1.71	1.56	1.33	1.43
November	1.93¾	1.78¾	1.58¾	1.65¾	1.73¾	1.58¾	1.35¾	1.45¾
December	2.03⅜	1.88⅜	1.68⅜	1.75⅜	1.72	1.57	1.29	1.46⅜
Average	1.74	1.59	1.39	1.46	1.77¾	1.62¾	1.41½	1.49⅞

INDIANA.

OPERATIONS IN 1904.

Indiana completed more wells and produced more petroleum in 1904 than during any previous year. It surpassed Pennsylvania in the quantity of its total output and ranked fifth in the list of oil-producing States. The year before it occupied sixth place, and in time it bids fair to surpass Ohio in the yield of Trenton rock petroleum. Unless the present productive area of the Buckeye State is extended or some new sections brought forward for development its petroleum output must continue to decline. On the other hand Indiana has a large amount of prospective territory in sight and for some time past has been completing more new wells every month than its more noted competitor. Ohio, however, has the advantage that it began to yield petroleum a number of years previous to the discoveries in Indiana that led up to the commercial development in the latter State.

The total petroleum production of Indiana in 1904 was 11,339,124 barrels, valued at $12,235,674. Compared with 1903 this represents a gain of 2,152,713 barrels in quantity and $1,761,547 in value. The figures for 1904 have never been surpassed since the State became, in 1891, a factor in the world's supply of petroleum. The total production for 1903 was 9,186,411 barrels and the value $10,474,127. In 1904 Indiana produced over 9.7 per cent of the total production of the United States, about 9.1 per cent in 1903, and the value of its product was greater in both years than that of either the California or the Texas product. Of the total quantity of Lima or Trenton rock petroleum produced in the United States in 1904, Indiana supplied 46 per cent and northwestern Ohio 54 per cent. In 1903 a little over 41 per cent came from Indiana and the remaining 59 per cent came from the Lima oil districts of Ohio.

There were 3,766 wells completed in the Indiana petroleum fields in 1904, which was 73 more than were completed in 1903, and the greatest number on record. Of the total, 400, or 10.6 per cent, were classed as unproductive. During 1903, 3,693 wells were completed, and of these 380 were unproductive. The dry holes were 10.3 per cent of the total number of wells drilled in 1903, as compared with 15 per cent in 1902, and with 16 per cent in 1901. The average initial production of the new wells for the last day of each month was 6,013 barrels in 1904, 4,250 barrels in 1903, and 3,772 barrels in 1902.

A large area of new and rich productive territory was added to the Indiana petroleum developments during 1904 in Grant and Delaware counties. This is generally known as deep-sand territory, and the most productive pay streaks are found at from 280 to 300 feet from the top of the Trenton limestone. Many of these wells started off at from 250 to 1,000 barrels a day and were responsible for the great increase in the total production of the State. Parker City, Selma, and Albany, in Delaware County, were the centers of greatest activity during the year.

The new pool near Princeton, Gibson County, attracted some attention in 1904, but the wells are small and the oil is dark, heavy, and of inferior quality. There is also a small development near Terre Haute, in the southern end of the State, which has been known for many years, but its total production has been very small, and efforts to extend its area have generally resulted in failure. Knox County, in the same section, has been the theater for considerable exploration, but the deepest tests have failed to bring forth anything more valuable than salt water. A well on the Bronillette farm, near Vincennes, was sunk to a depth of 2,071 feet without finding any traces of petroleum. There are small producing areas in other parts of the State which have called for a larger expenditure of money than was commensurate with their importance or productive capacity.

In Jasper County there were about 379 productive wells operated at the close of 1904, all of which will yield a small quantity of heavy lubricating oil. The company which controls the wells in this field states that it has been demonstrated that the crude oil produced is unexcelled in value from practical tests made with the oil on machinery, and especially as cylinder oils. The fire test is high, and, in fact, the oil has been used in 180-pound boiler pressure with superheated steam, bringing the fire test up to over 380°, and it has lubricated where all other oils have failed. The oil is too heavy to use in its natural state and has to be refined for the different uses of lubricating oil and to be mixed with lighter oils.

ILLINOIS.

No petroleum was marketed in Illinois during 1904, although several wells were drilled before the close of the year near Casey, in Clark County, a few miles west of Terre Haute, Ind., which have produced from 5 to 15 barrels per day at a depth of from 330 to 400 feet. The sand is said to be from 20 to 50 feet in thickness and corresponds with the horizon of the production at Princeton, Ind., which is in the Mansfield sand of the Lower Carboniferous formation, the equivalent of the Maxon sand of West Virginia. The color of the petroleum is of a dark brownish green, its gravity 33° Baumé, and it has a strong sulphureted hydrogen odor.

KANSAS.

OPERATIONS IN 1904.

From a small pool in the vicinity of Neodesha, in Wilson County, which ten years ago was producing from 40,000 to 45,000 barrels per annum, the Kansas petroleum fields have extended northeast and southwest until a stretch of productive territory has been opened that reaches from Miami County, in eastern Kansas, to the Arkansas River in the Indian Territory. Here is an area over 200 miles in length and from 10 to 80 miles in breadth, covering nearly 12,000 square miles, in which oil and gas have been found in commercial quantities. The petroleum-bearing formation is not uniform, and the petroleum is found in a series of detached pools, of smaller or larger proportions, like the pools or districts of Pennsylvania, West Virginia, and southeastern Ohio. The sands are not so regular, and are found distributed through the Cherokee shales, which have a thickness of about 450 feet, and whose base rests on the top of the Mississippi limestone. They correspond with the salt sand group of the Appalachian field.

The Kansas oil field proper covers entirely the counties of Allen, Montgomery, Wilson, and Neosho, with portions of Miami, Lyon, Anderson, Woodson, Chautauqua, Elk, and Labette. Crossing the Territorial line, it extends into the lands of the Osage Nation in Oklahoma and into the Cherokee and the Creek reservations of the Indian Territory. The petroleum varies greatly in gravity, the lighter and better qualities being found in the southern sections of the field. The lower-grade petroleums are being introduced into the Middle West for fuel purposes, while the oils ranging from 30° Baumé and above are manufactured into illuminating oils and other products.

The increase in the Kansas production from less than a million barrels in 1903 to 4,250,779 barrels in 1904, with the added production from the twin Territories on the south, creates a serious condition of affairs in relation to the commercial aspect of the petroleum situation. The refinery at Neodesha, with a capacity of 2,500 barrels a day, was totally inadequate to care for the rapidly increasing production. Another refinery, with a capacity of 5,000 barrels a day, was built below Kansas City, and a pipe line constructed, 116 miles in length, that connected it with the upper portion of the Kansas field at Humboldt. At the same time a large number of stock tanks were constructed to care for the surplus oil, lateral lines were laid in all directions to the new pools that were constantly being opened, and the system of carrying lines was extended into the Territorial oil fields. But the close of the year witnessed a production of upward of 25,000 barrels a day, while less than 8,000 barrels were being consumed. The remainder had to be stored in the big steel tanks of the pipe-line companies; prices were depressed, and the industry, which looked so promising at the beginning of the year, began to assume a most discouraging aspect. A pipe line was started to connect Kansas City with Whiting, Indiana, in order to afford the Kansas production an outlet to the eastern seaboard, but no relief from this source was experienced during the year.

The grading of the petroleum in accordance with its gravity and the lower scale of prices created considerable dissatisfaction among Kansas oil producers, and the year closed with the trade in a badly disorganized condition.

The Kansas petroleum is found in a sandstone formation ranging from 15 to 30 feet in thickness, and few of the wells are of very large caliber. Their staying qualities have been pretty thoroughly demonstrated, and their average yield is in excess of the average yield of the wells in the eastern petroleum fields. The oil-bearing strata dip rapidly toward the south, and as the depth increases the sand thickens and the wells develop a larger productive capacity. Across the line in the Territories some very large strikes have been made, equaling in size the more famous gusher wells of Pennsylvania, Ohio, and West Virginia.

In the Chanute oil district, in Neosho County, which was the first to develop petroleum after the discoveries at Neodesha, the petroleum sand occurs at a depth of 700 to 750 feet. The sand is soft and there are no well-defined pay streaks, as in most of the petroleum-bearing formations in the Eastern States. The wells are drilled with drilling machines and require about 200 feet of $8\frac{1}{4}$ and 600 feet of $6\frac{1}{4}$ inch casing. The oil is dark in color and from 28° to 29° Baumé. Some of the larger oil properties use compressed air for forcing the petroleum to the surface, but most of the wells are pumped by rod connections and shackle from a central pumping power driven by a gas engine.

In Montgomery County, in the southern part of the State, oil is found in several different formations. The production of the Wayside pool is from an upper sand 700 to 800 feet in depth, while the lower sand is found at from 1,350 to 1,450 feet. The oil is dark in color and from 34° to 36° Baumé gravity. In the Bolton pool, in the same county, the sand is found at from 1,100 to 1,200 feet.

Around Coffeyville, in the same county, the petroleum is found in three sands. The first contains the heavy oil and is found at a depth of 350 feet. The second sand, which lies 600 feet below the surface, produces oil of 32° gravity, and in it the best wells are obtained. The third sand is found at 900 feet, but very few of the wells are drilled to this formation. The sands are all of the black variety and range from 10 to 40 feet in thickness.

At Peru, in Chautauqua County, there is another pool of shallow sand oil, which has produced a large quantity of oil and is comparatively inexpensive to operate. The wells are drilled with a drilling machine at a cost of from 80 cents to $1 a foot. A 1,500-foot well in southern Kansas costs complete, with tank and rig, about $3,000.

Over 4,300 wells were producing petroleum in the Kansas and Indian Territory and Oklahoma oil fields at the close of the year, and the possible production, if all were set to working, was variously estimated at from 30,000 to 40,000 barrels a day. The runs by the pipe-line department of the Prairie Oil and Gas Company for December averaged 24,231 barrels a day; in January the runs averaged 9,107 barrels a day; this represented an increase in the daily production of about 166 per cent between January and December. The stocks in the custody of the pipe line increased from 718,757 barrels at the close of 1903 to 5,207,219 barrels at the close of 1904; this was a gain of 4,488,462 barrels, or 624 per cent.

As for the future of the Kansas petroleum fields, developments are bound to increase with the improved facilities for handling and storing the oil. New tankage is constantly being built and the producers continue to sink more wells. The field, as only partly developed, covers an area of upward of 12,000 square miles. There is little doubt that it will extend through the Indian Territory into northern Texas, and the southwestern end has not as yet been found. Traces of petroleum are reported in many different localities, and enthusiasts confidently assert that there are between 35,000 and 40,000 square miles of probable petroleum territory in the mid-continent section awaiting the exploration of the drill.

PRODUCTION IN KANSAS.

The total production of petroleum in Kansas for 1904 is given at 4,250,779 barrels, as compared with 932,214 barrels in 1903 and with 331,749 barrels in 1902. The increase in 1904 over 1903 was 3,318,565 barrels, or 356 per cent, the gain in 1903 over 1902 being 600,465 barrels, or about 181 per cent. In 1903 Kansas ranked eighth among the oil-producing States, but it rose to seventh place in 1904.

There was a heavy decline in the value of Kansas petroleum in 1904, the best grade, 32° Baumé and above, having dropped from $1.36 per barrel in January to 80 cents in December, while the lowest grade at the close of the year brought only 39 cents per barrel.

The total production of oil in Kansas, so far as records have been obtained, is as follows:

Production of petroleum in Kansas, 1889–1904.

[Barrels.]

Year.	Quantity.	Year.	Quantity.
1889	500	1897	81,098
1890	1,200	1898	71,980
1891	1,400	1899	69,700
1892	[a] 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	1904	4,250,779

[a] The production for this year does not appear in the table on page 19.

The following table gives the monthly production in Kansas from 1898 to 1904:

Production of crude petroleum in Kansas, 1898–1904, by months.

[Barrels of 42 gallons.]

Month.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	7,602	5,843	5,061	9,466	19,684	37,382	252,662
February	6,384	5,531	4,442	9,675	18,079	36,431	279,317
March	6,562	5,956	4,901	13,000	19,377	25,377	294,624
April	6,973	5,374	4,828	14,435	19,523	20,134	299,897
May	6,186	5,788	5,242	18,706	18,468	59,488	323,412
June	6,570	5,581	5,334	16,469	19,142	44,532	291,268
July	5,259	5,701	6,455	16,427	20,373	44,320	415,603
August	5,537	6,633	7,373	13,996	22,475	83,286	424,480
September	4,723	6,112	6,356	14,274	23,575	105,891	412,965
October	5,457	5,956	8,408	18,411	38,156	113,683	409,937
November	5,224	5,622	7,259	16,618	54,490	151,031	430,115
December	5,503	5,603	9,055	17,674	58,407	210,659	416,499
Total	71,980	69,700	74,714	179,151	331,749	932,214	4,250,779

Range of prices paid for Kansas and Indian Territory crude petroleum in 1904.

Date.	South Neodesha.	North Neodesha.	Kansas heavy.	Bartlesville.
January 1	$1.36	$1.16	$0.60	$1.14
February 12	1.31	1.11	.55	1.15
March 1	1.28	1.08	.55	1.12
March 4	1.25	1.05	.55	1.09
March 12	1.22	1.02	.55	1.06
March 29	1.19	.99	.55	1.03
April 8	1.16	.96	.55	1.00
April 29	1.13	.93	.55	.97
June 7	1.08	.88	.55	.92
June 17	1.03	.83	.55	.87
July 9	.95	.75	.50	a .95 b .79
July 12	.88	.68	.47	a .88 b .72
September 1	.90	.70	.49	a .90
October 18	.87	.67	.46	a .87

a In line. b On cars.

Date.	32° and above.	31½° to 32°.	31° to 31½°.	30½° to 31°.	30° to 30½°.	29½° to 30°.	29° to 29½°.	28½° to 29°.	28° to 28½°.	22° to 28°.
November 10	$0.87	$0.82	$0.77	$0.72	$0.67	$0.62	$0.57	$0.52	$0.47	$0.46
December 16	.82	.77	.72	.67	.62	.57	.52	.47	.42	.41
December 29	.80	.75	.70	.65	.60	.55	.50	.45	.40	.39

INDIAN AND OKLAHOMA TERRITORIES.

OPERATIONS IN 1904.

Great progress was made in the Indian and Oklahoma Territories petroleum fields in 1904, although development work has been somewhat retarded by the almost prohibitory restrictions and requirements imposed upon the oil leasers by the Interior Department.

A blanket lease covering the entire reservation of the Osage Indians in Oklahoma had been obtained by the Indian Territory Illuminating Oil Company, in 1896, and the developments in Kansas stimulated the exploration of the land across the border. The Osages leased their lands for ten years at one-tenth royalty. The Illuminating Oil Company subleased this land at one-sixth royalty and a bonus of from $1 to $5 an acre. These leases will expire in March, 1906, but operators holding partially developed properties expect them to be renewed. Good wells were discovered along almost the entire run of lots in the eastern edge of the Osage Reservation. For nearly 75 miles from the lower edge of Chautauqua County in Kansas to Red Fork in the Creek Reservation the petroleum development has continued with only a few breaks here and there. Cleveland, on the Arkansas River, marks the western edge of the Osage Reservation petroleum territory as at present developed. Oil has made the Osage the richest people in the United States, and their per capita wealth is greater than that of the people of any other State or Territory under the American flag.

Bartlesville is the center of petroleum operations in the Cherokee Nation. These lands are directly east of the Osage Reservation and are doubtless just as much in oil as the sections across the border. They are located in the Indian Territory, and all leases from the original owners have to receive the approval of the Interior Department at Washington. Severe restrictions are imposed upon those leasing the lands and heavy forfeitures have to be deposited in order to secure the fulfillment of the contracts. The process of obtaining a lease in the Indian Territory is attended by so many delays that the development of the lands of the Cherokees and the Creeks has been very slow. That a large area of land along the Verdigno River between Bartlesville and Chelsea will prove valuable for petroleum-producing purposes seems beyond the possibility of any doubt. In the Creek Reservation some very promising pools have been opened up at Tulsa and Red Fork and Muskogee in the Arkansas River Valley. Following the Arkansas River from Cleveland to Muskogee, a distance of 80 miles, there is a large scope of petroleum territory awaiting the drill that will be developed as soon as conditions become more favorable.

OKLAHOMA.

The Osage Nation petroleum district produced 56,905 barrels in 1903 and 652,479 barrels in 1904. This represents the petroleum that was marketed and sold. The output would have been much greater had the pipe-line facilities been equal to the task of handling the entire production. At the close of the year there were 243 producing wells in this field, and in addition to the petroleum cared for by the lines a large amount had accumulated in private tankage.

The Osage Reservation wells are from 1,300 to 1,600 feet in depth, and the oil formation is quite uniform. The difference in depth is due to the rolling character of the country, which is in sharp contrast to the flat prairie lands of the Kansas petroleum fields. A few deep sand wells have been drilled near Pawhuska, which are producing from a depth of nearly 2,000 feet. There are also a few shallow sand wells south of the Kansas line, which find their oil in the Peru sand at a depth of 700 feet. The regular petroleum sand is from 10 to 40 feet in thickness, and the gravity of the petroleum is from 34° to 36° Baumé. The initial production of the wells varies greatly. While small wells are numerous, some very large strikes have been made, and gushers of the 100-barrels-an-hour class are not entirely unknown.

Near Granite, Okla., is an undeveloped field, oil having been found in several places at a depth of from 150 to 200 feet. The oil is of a heavy lubricating character.

Development work is in progress in Oklahoma County where the deepest well in this Territory is now being drilled. The well at present writing is 1,900 feet deep. At a depth of over 1,600 feet the red beds were encountered. At a depth of 606 feet a coal vein of 4 feet was passed through. The well is cased to the bottom, the fourth string of casing in, and formation getting better.

At Newkirk a well is producing a small amount of lubricating oil which is sold to local consumers for lubricating purposes at 20 cents a gallon.

Wells drilled in Comanche County have developed oil and gas, but there is no market for the product and none was marketed in 1904.

INDIAN TERRITORY.

Muskogee in the Creek Nation marks the extreme limits of the southeastern section of the Indian Territory petroleum fields. Here nearly 50 wells have been drilled and a petroleum of a dark green color obtained with a gravity of 42° Baumé. The wells are about 1,200 feet in depth and the oil sand 25 feet in thickness. In drilling about 600 feet of 6¼-inch casing is required.

Bartlesville thus far has proved the source of the largest supply of petroleum in the Indian Territory. It is also noted for several remarkable gas wells. A small pool of petroleum has also been opened up west of Chelsea and development promises to be quite active during the coming year.

PRODUCTION IN INDIAN AND OKLAHOMA TERRITORIES.

In the following table is given a statement of the quantity of crude petroleum produced and sold by the Indian Territory Illuminating Oil Company and its sublessees from wells in Osage Nation, Oklahoma, from January 1, 1903, to December 31, 1904:

Production of crude petroleum by the Indian Territory Illuminating Oil Company and its sublessees from January 1, 1903, to December 31, 1904.

[Barrels of 42 gallons.]

Month.	1903.	1904.	Month.	1903.	1904.
January	7,147	10,338	August	4,386	49,907
February	5,697	10,133	September		82,156
March	3,907	9,428	October	8,109	115,118
April	6,749	11,998	November		118,206
May	3,255	12,888	December	6,278	197,538
June	6,211	12,143	Total runs	56,905	652,479
July	5,166	22,626			

At the close of 1904 the above company had completed 361 wells, of which 243 were oil wells, 21 gas wells, and 97 dry holes, and 70 were drilling. On the 1st of January, 1903, only 30 wells had been completed, 17 of which were oil wells, 2 gas wells, and 11 dry holes.

The following table shows the production of petroleum in Indian and Oklahoma Territories from 1891 to 1904, inclusive:

Production of petroleum in Indian and Oklahoma Territories, 1891–1904.

[Barrels.]

Year.	Quantity.	Year.	Quantity.
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	1904	[a]1,366,748

[a] Oklahoma included since 1901.

Production of petroleum in Indian and Oklahoma Territories in 1902, 1903, and 1904, by months.

[Barrels.]

Month.	1902.	1903.	1904.	Month.	1902.	1903.	1904.
January	983	7,146	30,847	August	2,457	10,491	124,995
February	703	5,697	35,449	September	4,444	8,831	119,846
March	1,009	4,147	44,850	October	5,733	14,326	192,000
April	583	7,034	50,095	November	7,043	24,720	211,161
May	2,501	4,287	61,303	December	8,614	27,869	335,937
June	1,764	8,250	65,671	Total	37,100	138,911	1,366,748
July	1,266	16,113	94,594				

LOUISIANA.

OPERATIONS IN 1904.

This is but the third year in which this State has produced petroleum, yet its record for 1904 shows a production of 6,611,419 barrels. Of this amount only 2,941,419 barrels were marketed, which latter quantity shows a gain of 220 per cent over that of 1903. Louisiana is now eighth in the rank of producing States, and ninth in rank when the value is considered. If the entire production of the State was considered it would rank seventh, next to Pennsylvania. The entire production for the first seven months of 1904 was but one-tenth of that of the last five months. A new and prolific section to the southeast of the original Jennings pool was developed in 1904. In August, 1904, a well started flowing through 2½-inch tubing at the rate of about 5,000 barrels per day. Another well, which came in on September 8, produced at the rate of 16,000 barrels per day for the first week from a depth of 1,900 feet. This well, by the close of 1904, produced 1,280,000 barrels, averaging nearly 11,228 barrels per day, which probably is greater than the output of any single well for the same period on this continent.

The developments at Jennings indicate that there is a buried anticlinal in this locality running northeast and southwest, with well-marked slopes to the southeast and northwest. As there is a difference of more than 100 feet in the depth of the wells located on the slopes of this anticlinal, some salt water is encountered on the southeast slope. The extent of this field has not yet been determined. The production for the last four months of 1904 was about 40,000 barrels per day, and at the close of the year it was nearly 60,000 barrels per day. There is more or less loose sand coming up with the petroleum in most of these wells, which it is necessary to keep back by a strainer or by slatted casing. In the Jennings field about 95 wells have been completed up to the close of 1904. Of this number 60 were productive, and 40 were producing at the close of the year.

The Jennings pool was opened up by the Scott Heywood well in the spring of 1902. The original wells were small producers.

The Welsh field, 12 miles west of Jennings, produced 35,892 barrels in 1904. Operations have not been so vigorous in this field, and the wells are not so productive. The petroleum is used principally for fuel, although a portion is used for lubrication.

The Anse la Butte field, located about 6 miles north of Lafayette, has produced some petroleum. The field has not been vigorously developed, and the indications are that its production could be largely increased if a profitable market could be secured.

Near the close of the year operations were begun in Caddo Parish, in the extreme northwestern corner of the State, which bid fair to develop both petroleum and natural gas. More or less natural gas and petroleum have been found in Sulphur, Calcasieu, Lake Charles, and Cowley, which are at present undeveloped. The great area of flat, almost level plains in this State no doubt have covered up numerous irregularities of the underlying and older strata, where structural conditions exist favorable for the accumulation of petroleum and natural gas, that can only be located by the drilling of wells and careful deductions secured from their records. The gravity of the petroleum produced runs from 21° to 25° Baumé.

Pipe lines.—Three pipe lines extend from the field to the Southern Pacific Railroad.

The Jennings Oil Company and Heywood Brothers operate a 4-inch line to a point on the Southern Pacific near Jennings, with a loading station on an arm of the Mermentau River, 2 miles from the field. This line is about 5 miles long.

The Phœnix pipe line is an 8-inch line extending to the Southern Pacific at Mermentau, on the Mermentau River. This line is 4 miles long.

The Crowley Oil and Mineral Company's line is 4 inch, and extends to Egan on the Midland branch of the Southern Pacific. It is about 3 miles long and is operated by the Sterling Oil Company.

Oil is loaded on tank cars and shipments are made from Jennings, Mermentau, and Egan, stations on line of Louisiana Western Railroad Company.

Considerable oil is loaded on barges and transported on the Mermentau River to rice farm irrigating plants, but the majority goes out by rail.

Tankage.—There are about 6,000,000 barrels of petroleum in earthen storage tanks, and 355,000 barrels in iron tankage in the Jennings field and at the loading racks near the railroad.

PRODUCTION, PRICES, AND SHIPMENTS OF LOUISIANA PETROLEUM.

Production of petroleum in Louisiana in 1902, 1903, and 1904, by months.

[Barrels.]

Month.	1902.	1903.	1904.	Month.	1902.	1903.	1904.
January	....	46,560	54,018	August	92,894	78,017	339,577
February	....	65,108	32,983	September	68,723	67,345	519,486
March	....	82,900	35,713	October	81,257	66,630	528,797
April	....	83,725	60,343	November	70,707	63,994	555,860
May	25,000	75,279	82,722	December	75,036	95,603	573,168
June	60,000	97,137	82,398	Total	548,617	[a] 917,771	[b] 2,941,419
July	75,000	95,473	76,354				

[a] One company's production averaged.
[b] In addition to this quantity it is estimated that about 3,670,000 barrels were produced and unsold at the close of 1904, making the total production for the year 6,611,419 barrels.

In the following table is given a statement of production and value of crude petroleum in Louisiana in 1902, 1903, and 1904, by fields:

Production and value of petroleum in Louisiana in 1902, 1903, and 1904, by fields.

[Barrels.]

Year.	Jennings.		Welsh.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1902	548,617	$188,985	....	....	548,617	$188,985
1903	892,609	391,066	25,162	$25,162	917,771	416,228
1904	2,905,527	1,044,155	35,892	24,450	2,941,419	1,068,605

Average monthly price of crude petroleum per barrel at wells in the Jennings oil field in the year 1904.

Month.	Price.	Month.	Price.	Month.	Price.
January	$0.30	May	$0.46 to $0.50	September	$0.30 to $0.44
February	.30	June	.50 to .52	October	.30 to .46
March	.40	July	.45 to .57	November	.22 to .35
April	$0.40 to .50	August	.40 to .50	December	.18 to .33

The following table gives a statement of shipments of crude petroleum from stations on the line of the Louisiana Western Railroad Company in Louisiana during the year 1904, by months:

Rail shipments of crude petroleum from Jennings, Mermentau, and Egan stations, Louisiana, during the year 1904, by months.

Month.	Jennings.		Mermentau.		Egan.		Total.	
	Cars.	Barrels.	Cars.	Barrels.	Cars.	Barrels.	Cars.	Barrels.
January	272	[illegible]	21	[illegible]	....	....	[illegible]	[illegible]
February	[illegible]	[illegible]	15	[illegible]	....	....	[illegible]	[illegible]
March	[illegible]	[illegible]	35	[illegible]	....	....	[illegible]	[illegible]
April	[illegible]	[illegible]	[illegible]	12,159	....	....	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
October	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
November	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
December	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOTE.—The above are the official figures, calculations being made on the basis of [illegible] pounds of crude petroleum to a barrel of 42 gallons.

	Barrels.
Estimated production of crude petroleum in Louisiana in 1904	[illegible]
Shipped by railroad in 1904	[illegible]
Gross stocks in storage	[illegible]

TEXAS.

OPERATIONS IN 1904.

The production of petroleum in Texas in 1904 was 22,241,413 barrels, valued at $8,156,220, an average price of 36.7 cents per barrel, which was an increase in quantity of 4,285,841 barrels, or 23.87 per cent, and in value of $638,741, over 1903. This quantity equals 19 per cent of the entire production of the United States, and places Texas next to California and second in rank of the producing States. The value of the production in Texas was $8,156,220 in 1904, which represents 8.06 per cent of the total value and places this State sixth in the rank of States.

The shifting nature of the pools in southeastern Texas is illustrated by the fact that the Beaumont and the Sour Lake and Saratoga pools in 1903 produced 17,449,064 barrels, which was almost evenly divided between them, and that the Batson pool, which was just beginning to produce at the close of 1903, produced only 4,518 barrels. In 1904 the entire production of the Beaumont, the Sour Lake, and the Saratoga pools was 10,615,438 barrels, and the new Batson pool alone produced 10,904,737 barrels. The Matagorda pool produced 151,936 barrels.

making a grand total of 21,672,111 barrels in southeastern Texas in 1904, which was secured from about 650 producing wells.

The largest decrease in production was in the original Beaumont pool, which for 1904 was 3,433,842 barrels, as compared with 8,600,905 barrels in 1903. The new Humble field, 16 miles north of Houston, in Harris County, was not fully opened until in 1905. The great coastal plain of southeastern Texas has produced a number of prolific fields where the sand has been found saturated with petroleum under natural gas pressure. In most of the instances there was nothing on the surface to indicate the existence of these deposits. The monotonous gentle slope was toward the Gulf, with a profusion of slight mounds, the regularity of which is at intervals interrupted by streams flowing toward the Gulf. From indications at the close of 1904 it is reasonable to infer that southeastern Texas will very considerably increase its output in 1905, and that immense quantities of fuel petroleum will be produced and marketed.

The drilling of wells has in several instances revealed the existence of the underlying deposits of petroleum and natural gas under great pressure, which have in numerous instances responded in a most remarkable manner. There are, therefore, many possibilities that the drill will continue to develop these buried deposits that are not indicated by any structural condition of the surface. In some instances the wells drilled have developed an anticlinal structure on whose flank large flows of salt water have been encountered.

All of the fields so far developed in southeastern Texas have suffered more or less from the presence of salt water, which, as the internal pressure decreases, follows up the flanks of the deposit and shuts off the flow of petroleum. In numerous instances air pressure has for a time counteracted its bad effect, but the relief was only temporary.

DISTRICTS.

SPINDLE TOP POOL.

The original well that opened up this pool, located 4 miles south of Beaumont, was drilled January 10, 1901, and began to flow at the rate of 70,000 barrels per day, which was without a precedent in this country; and since the beginning to the close of 1904 this pool, consisting of 200 acres, has produced and sold 33,050,000 barrels, to which must be added 1,500,000 that were wasted and consumed by fire, making a grand total of 34,500,000 barrels, sufficient to cover the entire area to a depth of 22 feet. Over 1,200 wells have been drilled on this limited area at a depth of from 1,000 to 1,060 feet, which does not include the number of dry holes that have surrounded the productive area. At the close of 1904 about 95 wells, none of which were flowing, were producing less than 6,000 barrels per day. The remaining

1,105 were lost, some through faulty drilling and casing, others ceased soon after completion to be productive, and finally many others had to be abandoned owing to the inflow of salt water in large quantities.

SOUR LAKE POOL.

This pool lies 20 miles northwest of Beaumont. Three or four shallow wells had developed a heavy, dark petroleum 4 or 5 years before the development at Spindle Top.

The earliest work in this field was done in 1893. During the summer of 1901 the Guffey Petroleum Company drilled in a well in this locality which gave spasmodic flows of petroleum, accompanied by gas and water. Since then there have been secured from this pool up to the close of 1904 over 14,800,000 barrels of petroleum. The gravity ranges from 14° to 22° Baumé. At the close of 1904 there were 105 wells, producing 11,500 barrels per day.

SARATOGA DISTRICT.

This pool is located 10 miles northeast of Sour Lake and has been a comparatively small producer. Its production in 1903 was estimated to be 160,000 barrels, that for 1904 was 739,239 barrels, making a total of about 900,000 barrels. The petroleum produced in this pool is heavy, ranging from 14° to 20° Baumé. The developments were much more active in 1904 than formerly. At the close of 1904 there were 38 wells, producing 20,000 barrels per day, with considerable area undeveloped.

BATSON PRAIRIE DISTRICT.

This pool is located 8 miles west of Saratoga and was remarkable for its sudden development and rapid decline. Owing to the erratic behavior of the wells it was one of the features of the development in southeastern Texas during 1904. During 1903 there were but 4,518 barrels produced in this pool, as it had just been discovered, but in 1904 it produced 10,904,737 barrels of petroleum, falling off remarkably at the close of the year. Two hundred and sixty wells were producing 11,700 barrels per day. The falling off was due principally to the flooding of a large portion of the productive area by salt water. The gravity of the petroleum produced in this pool is lighter and superior to the general average produced in southeastern Texas. It ranges from 23° to 24½° Baumé, although some petroleum as light as 28° Baumé was produced.

MATAGORDA POOL.

This pool was opened during 1904 and is the furthest development in a southwest direction, as it is 80 miles from Houston, on an elevation known as Big Hill, 3 miles from the town of Matagorda. During 1904 it produced 151,936 barrels of petroleum of a dark-green color and of 19° to 20° Baumé gravity. At the close of 1904 there were about 30 wells producing, a number of wells having been abandoned on account of salt water. Many of the wells were erratic in their behavior and at times produced large quantities of petroleum mixed with salt water. Eventually they produced nothing but salt water. The production is carried by pipe line to the Cane Belt Railroad by the Big Hill Oil and Fuel Company and the Matagorda Oil and Pipe Line Company, and shipped in tank cars and marketed for fuel.

HUMBLE DISTRICT.

The new Humble pool, in Harris County, 16 miles north of Houston, was not fully opened during 1904. There were two productive wells at the close of 1904 that were not producing regularly. About 2,000 barrels of petroleum were produced, which was stored in earthen tanks for fuel. None was sold. The Beatty well was the first to be completed and commenced to produce in January, and a number were drilling at the close of the year in this pool. None of the production was marketed until January, 1905, when it commenced to assume importance, and in April it was reported to have produced nearly 2,000,000 barrels.

CORSICANA DISTRICT.

This was the first regular district opened up in Texas. Since 1897 it has produced more than 500,000 barrels per year, and for the past two years its production was very close to that amount.

There are two grades of petroleum produced in this field—the lighter and superior grade being classed as Corsicana and the latter as Powell petroleum. In 1904 there were 374,318 barrels of Corsicana and 129,329 barrels of Powell petroleum produced. For several years there has been a decline in the production of the Corsicana petroleum, while both 1903 and 1904 have shown an increase in the production of the Powell petroleum. The average price paid in 1904 for the Corsicana petroleum was 87 cents per barrel and 43 cents for that classed under the head of Powell. The gravity of the Corsicana petroleum is about 40° Baumé; that of the Powell district is considerably heavier and produces a less percentage of lighter and desirable products.

There were 74 wells completed in these fields in 1904, of which 46 were producers, 25 were dry, 3 produced gas, and 31 were abandoned. One old well was drilled deeper and produced gas.

SOUTH BASQUE DISTRICT.

At South Basque, McLennan County, 70 miles southwest of Corsicana, 2 wells have been completed at between 450 and 475 feet in depth, which will produce from 3½ to 5 barrels per day of light petroleum, with a gravity ranging from 42° to 25° Baumé. Three other wells did not find the producing horizon, which in this field resembles rotten blue shale. Developments are still in progress, but no petroleum was shipped in 1904, all the production being used in the field for fuel.

HENRIETTA DISTRICT.

This field is located in Clay County near the Red River, on the northern border of Texas, and 150 miles northwest of Corsicana. There were several wells drilled in this locality previous to 1904, but the production and shipment date from this year. In 1904 there were 65,455 barrels produced, valued at 47½ cents per barrel. There were 80 producing wells completed, most of which produced only from 3 to 40 barrels per day, found at a depth of from 300 to 320 feet, where a gray sand is found. The quality resembles that found at Corsicana, showing 33° Baumé, and has a paraffin base. Most of the production is shipped to the refinery at Corsicana.

The field is connected by two pipe lines leading to the racks at Petrolia Station, 1½ miles distant. An analysis made in a laboratory still gave naphtha, 9.1 per cent; water white, 54.5 per cent; solar oil, 13.6 per cent; heavy distillate, asphalt, water, and loss, 22.8 per cent.

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.

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.

BRAZORIA COUNTY.

At Kiser Hill, near Columbia, Brazoria County, petroleum of good lubricating qualities has been developed, which, owing to a lack of transportation facilities, was not operated during 1904.

INVESTMENT IN THE PETROLEUM INDUSTRY IN TEXAS.

The following statement covering a period of four years, beginning January 1, 1901, and ending December 31, 1904, is taken from the Oil Investors' Journal, and conveys some idea of the large investment of capital required to secure and handle the vast production in Texas, so rapidly developed:

3,210 wells, at $2,500 each	$8,025,000
Equipping wells	1,550,000
Construction of 513½ miles of pipe line	2,743,000
Construction of 10,015,000 barrels of steel tankage, at 25 cents per barrel	2,503,750
Construction of 10,193,000 barrels of open earthen tankage, at 13 cents	1,325,090
Construction of 7,232,000 barrels of covered earthen storage	1,229,460
Construction of 650,000 barrels of wooden tankage	260,200
Construction of refineries to handle 20,000 barrels of crude oil, daily	8,000,000
Cost of 2,000 oil-tank cars, at $1,200 each	2,400,000
Cost of 60 steamers, tugs, and barges for oil trade	6,000,000
Total	34,036,500

PIPE LINES IN OPERATION IN TEXAS.

At the close of 1904 there were 513½ miles of trunk pipe lines from 4 to 8 inches in diameter operated by the following named companies:

	Miles.
J. M. Guffey Petroleum Company	135
The Texas Company	126
Security Oil Company	126
The Sun Company	38½
National Oil and Pipe Line Company	18
Higgins Oil Company	22
United Oil and Refining Company	30
Raywood Rice Company	18
Total	513½

Besides these, there are a number of companies who have short pipe lines to loading racks at the railroads, operating under the following titles: Heywood Oil Company, Higgins Paraffin Pipe Line Company, Rio Bravo Oil Company, J. M. Abbott Oil Company, Sour Lake Storage and Pipe Line Company, and Lone Star and Crescent Company, making fourteen companies which handle crude petroleum and which have reported.

The shipment by water of crude and refined petroleum increased from 8,000,339 barrels in 1903 to 10,054,036 barrels in 1904; of this quantity about 70 per cent went to New York and Philadelphia and 9½ per cent went to foreign countries, which latter in 1904 amounted to 40,266,186 gallons, valued at $2,026,756, and included crude, lubricating, and illuminating petroleum and residuum, as compared with 20,900,309 gallons, valued at $520,626 in 1903. There were 1,374,106 barrels of crude and refined petroleum shipped to various places in Louisiana, most of which went to Gretna, opposite New Orleans, and from this point was distributed by vessels and boats on the Mississippi, and by rail.

Illuminating petroleum and gasoline manufactured at Beaumont, Port Arthur, and Sabine Pass are finding a market in the South and West, although their gravity and fire test are somewhat higher than in the manufactures from Pennsylvania petroleum; however, their efficiency is generally satisfactory to the consumers. From the lighter crude produced at Sour Lake and Batson about 3.5 per cent of gasoline (66° test) is secured, 14.5 per cent of illuminating petroleum or kerosene (120° test), and 55 per cent of gas oil, the remaining 27 per cent being residuum and loss.

PRODUCTION OF PETROLEUM IN TEXAS.

The production of petroleum in Texas since 1889 has been as follows:

Production of petroleum in Texas, 1889–1904.

[Barrels.]

Year.	Quantity.	Year.	Quantity.
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	1904	22,241,413

Production of crude petroleum in Texas, 1895–1904, by districts.

[Barrels.]

Year.	Corsicana.	Powell.	Beaumont.	Sour Lake.	Saratoga.	Batson.	Matagorda.	Henrietta.	Total.
1895									50
1896	[a]1,450								1,450
1897	[a]65,975								65,975
1898	544,620								[b]546,070
1899	668,483								[b]669,013
1900	829,560	[a]6,479							836,039
1901	763,424	[a]37,121	3,593,113						4,393,658
1902	571,059	46,812	17,420,949	44,838					18,083,658
1903	401,817	100,143	8,600,905	8,848,159		4,518			[a]17,955,572
1904	374,318	129,329	3,433,842	6,442,357	739,239	10,904,737	151,936	65,455	[a]22,241,413

[a] Includes a small quantity produced elsewhere in the State.
[b] Includes a small quantity produced outside of the Corsicana field.

CALIFORNIA.

OPERATIONS IN 1904.

The most remarkable event in the production of petroleum in the United States in 1904 was the increase in California. The output of this State has been increasing by leaps and bounds since 1899. It has increased sevenfold since 1900. For the last two years it has produced more than any other State, the output amounting to 25.33 per cent, or more than one-fourth of the entire production of the United States.

As a large percentage of the petroleum produced is used for fuel, it was marketed at a low value, about 63 per cent being sold for 17½ cents per barrel, nearly all of which was produced in Kern County. The highest price paid was $2 per barrel for a small production of a superior grade of petroleum in San Mateo County. The entire value of the production in 1904 was $8,265,434, which amount placed California in the fifth place when rank in value of the States producing petroleum was considered. The average price paid in 1904 was about 28 cents per barrel, a decline of about 2 cents compared with 1903.

The largest percentages of gain in production were, in the order named, Santa Clara, Santa Barbara, Fresno, and Ventura counties. The only county showing a decline was San Mateo.

On December 2, 1904, a remarkable well was drilled in at a depth of 2,860 feet, in Santa Barbara County, a few miles southeast of Santa Maria, belonging to the Union Oil Company, which began producing at the rate of 10,000 barrels per day. The gravity is 22.8° Baumé. Immense quantities of loose sand were vomited out of this well with the petroleum, which in a short time covered the derrick floor for a number of feet. At a depth of 2,200 feet a deposit of petroleum was found in a loose sand which would have made from 300 to 500 barrels per day, but this was cased off, and the well drilled deeper. Owing to lack of tankage, attempts were made to "shut in" this well without success. Finally the pipe parted 90 feet from the well's mouth. The petroleum is now flowing out of the cracks in the ground at different points from 2 to 3 rods away from the well, as well as through lead lines, and is collected in temporary drains across the canyon.

The Union Oil Company had about 200,000 barrels, which at first was stored in these reservoirs and subsequently was shipped by a pipe line to tanks at Gaviota. The Brooksline Oil Company had several wells near this large gusher, and they closed down at once. One of these wells afterwards broke loose and started to flow at the rate of 4,000 barrels per day. Indications are that this territory extends from 8 to 9 miles to Lompoc, and that it will contribute largely to the production in 1905. The petroleum ranges from 22° to 28° Baumé. The lighter grades are found in the northern portion of the field.

There were 458 wells drilled in 1904, of this number about 158 were dry, leaving 300 productive wells. There were 252 wells abandoned. During the year there were 2,772 wells operated and 647 wells shut in. About 75 per cent of the new wells drilled were in Kern and Los Angeles counties. There were 57 rigs up at the close of 1904.

There were 398 wells drilled in 1903. Of these 75 were dry holes, and 77 rigs were up at the close of the year.

FIELDS.

KERN COUNTY.

The Bakersfield district in Kern County kept up its production of nearly 55,000 barrels per day in a remarkable manner, although at times more than half of the wells in this field were shut in for want of transportation. The specific gravity averages 15½° Baumé.

There were over 3,000,000 barrels held in steel and 3,500,000 barrels held in earthen reservoirs in this field at the close of 1904. Large quantities were shipped north by the Pacific Coast Oil Company's line to Point Richmond, and from 150 to 200 tank cars were shipped daily from this field in 1904.

FRESNO COUNTY.

The Coalinga field in Fresno County in 1904 more than doubled its production of 1903, yielding 5,114,958 barrels. The gravity of the petroleum produced in this field ranges from 12° to 45° Baumé, the larger proportion being about 33° Baumé. There were 148 producing wells during 1904 and 11 wells shut in for want of transportation. Four pipe lines from 5 to 10 miles in length connect this field with the tanks on the Southern Pacific Railway near Coalinga.

The Pacific Coast Oil Company's branch line from Coalinga reaches the main line at Mendota Station, 166 miles south of Point Richmond. In October a 6-inch pipe line was completed to the Pacific coast at Montgomery Bay, distant about 100 miles.

One of the serious obstacles to the more rapid development of this field is the scarcity of water. There is a partial supply furnished by two water pipe lines operated by the Coalinga Consolidated Water Company, which secures it from wells in the valley.

LOS ANGELES COUNTY.

The Los Angeles field, in Los Angeles County, in 1904 slightly more than maintained the production of the previous year. The production in 1904 was 2,102,892 barrels, the product of 1,273 wells. There were 148 wells drilled and 99 abandoned during the year. The specific gravity averaged about 13° Baumé.

SANTA BARBARA COUNTY.

The production in this county increased 158 per cent in 1904 over that of 1903, owing to the immense wells opened up toward the close of the year near Santa Maria, with indications of a much larger increase in 1905. The particulars of the well secured by the Union Oil Company have already been described. Wells near Summerland, in this county, have long been noted, owing to their rigs being located on piles in the ocean.

VENTURA COUNTY.

The wells are quite deep in this field, many are over 2,000 feet, and a great part of the petroleum is as light as 25° Baumé, some of it going up to 35° Baumé. There was a marked increase in the production in 1904 over that of 1903, amounting to 49 per cent, and the price averaged about 90 cents per barrel, which was the highest paid for crude petroleum in California during 1904, except for a small production in San Mateo County.

SAN LUIS OBISPO COUNTY.

A report by Mr. H. W. Fairbanks, on the mineral resources of the quadrangle embracing the western central portion of this county, has recently been completed, which states that important deposits of bituminous rock are chiefly found in the Pismo sandstone formation, capping the Montgomery shale. The character of this sand is open and porous, readily absorbing the liquid bitumens; it belongs to the Miocene age. There are numerous springs of petroleum and deposits of asphalt, from thick tarry masses to solids. No productive wells have as yet been drilled in this quadrangle, although there are many indications of large deposits of petroleum in the sands where structural conditions are favorable.

PETROLEUM FUEL.

The immense production of heavy petroleum in California in 1904, amounting to about 23,000,000 barrels, which represents 6,390,000 tons of such coal as was formerly used in California, has solved the cheap fuel problem for the Pacific coast, and has demonstrated the possibilities of its becoming a great manufacturing district. The cost per barrel delivered at San Francisco is from $1.40 to $1.50, and as 3.8 barrels equal one ton of average coal, the equivalent of one ton of coal would cost about $5.50.

There are now 140 steamers, large and small, using petroleum that ply in and out of San Francisco, aggregating about 130,000 gross tons. There are petroleum fuel storage stations at the Hawaiian Islands and in Alaska, also at a number of ports in Asia, but most of the steamers take sufficient petroleum fuel to make the outward and return trip.

As 1,200 pounds of petroleum are equivalent to 1 ton of 2,000 pounds of coal, there is a saving of 40 per cent in weight. If a double supply was loaded, the excess of weight would only be 20 per cent. The steamship *Mariposa* has been making regular trips between San Francisco and Tahiti for several years, the round trip being over 7,500 miles. The oil tanks were constructed out of the coal bunker space forward of the boilers and separated from the boiler room by a water-tight bulkhead 4 feet between walls, and 48 feet farther forward a similar bulkhead was constructed. This tank space was divided by a middle and two cross-wise divisions, making six compartments. Each had a small opening at the top to permit the gas to pass off to the ventilating tank. The total capacity of these tanks was about 905 tons, or 6,338 barrels. While the petroleum fuel as installed on the *Mariposa* was in every way satisfactory, the result of the trials do not give a comparison with coal fuel. More perfect comparative tests were made on the sister ship to the *Mariposa*, the *Alameda*, running between San Francisco and Honolulu, Hawaii, as to the relative value of petroleum and the ordinary bituminous coal purchased at San Francisco, Cal. The results of a number of these carefully made tests show that 1 pound of petroleum does the same work in evaporating water in boilers that requires 1.42 pounds of coal, which gives 4.2 barrels of petroleum equal to 1 ton of coal, and as 1 pound of petroleum in San Francisco costs less than 1 pound of pea coal the economy is apparent. It will be remembered that these results were obtained when the crew of the *Alameda* was inexperienced in firing with petroleum, and better results have since been secured. The comparative cost of the fuel is not the only advantage in using petroleum fuel. Other advantages are: Dispensing with the services of over one-half of the crew in the fireroom; a great increase in the radius of the fuel limit; increased evaporative power of the boilers; quick manner in which steam can be raised and the development of the boilers' maximum capacity; shutting off of the flow to the boilers when the demand suddenly ceases; and absence of smoke, dust, and dirt incident to shipping a supply of coal. There is also a great advantage in the manner in which liquid fuel can be stored in the double bottom where it would be impossible to store coal. The use of liquid fuel requires extra care in securing petroleum which has had the more volatile portions driven off by distillation or heating, as all crude carries a slight percentage of the more volatile petroleum, and in the removal of gases that will collect in the upper portions of tanks as the fuel is removed, and in the complete removal of the possibility of the jumping of an electric spark into the fuel tanks. The flash test should not be less than 180° F.

The United States Naval Liquid Fuel Board made an exhaustive test with Texas crude petroleum in 1904, burned under a Hohenstein water tube boiler, at Washington, D. C., under conditions similar in many respects to those of actual service on shipboard.

One of the most interesting tests of petroleum fuel on ocean freighters was made in 1904 when the steamship *Nebraska*, owned by the American Hawaiian Company, steamed from San Francisco by way of Cape Horn to New York and returned, using petroleum fuel that was stored in her double bottom and in a large tank; she loaded at

San Francisco on the outward trip, and made a run of 26,000 miles in 105 days, returning June 12, 1904. Only one stop was made on the outward journey, owing to severe weather in the Straits of Magellan, the *Nebraska* being the first vessel burning petroleum fuel to pass these straits. This is probably the longest trip on record made without any supplies of petroleum from way stations.

Petroleum fuel is being introduced into smelters in California and in Arizona, and has for several years superseded coal to a very great extent in the generation of steam.

PETROLEUM USED IN ROAD MAKING.

California was the first to introduce petroleum as a top dressing in improving roads, which has lately caused a demand for heavy natural asphalt petroleum and for the manufactured article. It is particularly well adapted to a country where the roadbed is dusty or sandy. Its efficiency depends upon cementing the top of the road into a compact and strong covering, thus preventing the dust in a dry season and the mud in a wet season. Numerous trials have proved its benefit and durability, although retouching is necessary as local defects may develop. With petroleum at from \$1.25 to \$1.50 per barrel, a 12-foot roadway can be constructed under ordinary conditions at an outlay of from \$250 to \$600 per mile.

Other important uses of petroleum are the protection of river levees and the covering of bridges or wooden structures with a coating of gravel and heavy petroleum or asphalt.

PRODUCTION OF PETROLEUM IN CALIFORNIA.

In the following tables is shown the production of petroleum in California by years, by counties for 1904, and by counties for various years:

Production of petroleum in California, 1876–1904.

[Barrels.]

Year.	Quantity.	Year.	Quantity.
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	1904	29,649,434

Production of crude petroleum in California in 1903 and 1904, by counties.

[Barrels.]

County.	1903. Quantity.	1903. Total value.	1903. Value per barrel.	1904. Quantity.	1904. Total value.	1904. Value per barrel.
Fresno	2,138,058	$705,559	$0.33	5,114,958	$1,520,847	$0.297
Kern	18,077,900	3,796,359	.21	19,608,045	3,431,408	.175
Los Angeles	2,087,627	1,303,406	.624	2,102,892	1,238,732	.589
Orange	1,413,782	1,097,290	.776	1,473,335	1,147,139	.7786
Santa Barbara	306,066	159,833	.522	789,006	445,292	.564
Ventura	348,295	322,342	.926	517,770	465,180	.898
San Mateo	5,137	9,837	1.915	1,500	3,000	2.00
Santa Clara	5,607	4,723	.842	41,928	13,836	.33
Total	24,382,472	7,399,349	.303	29,649,434	8,265,434	.279

Production of crude petroleum in California, 1897–1904, by counties.

[Barrels of 42 gallons.]

Year.	Fresno.	Kern.	Los Angeles.	Orange.	Santa Barbara.	Ventura.	Santa Clara.	San Mateo.	Total.
1897	70,140	....	1,318,853	12,000	130,136	368,282	4,000	....	1,903,411
1898	154,000	10,000	1,470,990	60,000	132,217	427,000	3,000	....	2,257,207
1899	439,372	15,000	1,373,576	108,077	208,370	496,200	1,500	....	2,642,095
1900	532,000	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
1904	5,114,958	19,608,045	2,102,892	1,473,335	789,006	517,770	41,928	1,500	29,649,434

[a] Includes 225,000 barrels unapportioned.

WELL RECORD.

Well record in California in 1901, 1902, and 1903, by months.

Month.	Wells completed. 1901.	Wells completed. 1902.	Wells completed. 1903.	Initial production (barrels). 1901.	Initial production (barrels). 1902.	Initial production (barrels). 1903.	Dry holes. 1901.	Dry holes. 1902.	Dry holes. 1903.	Wells drilling. 1901.	Wells drilling. 1902.	Wells drilling. 1903.	Rigs building. 1901.	Rigs building. 1902.	Rigs building. 1903.
January	168	43	17	5,060	1,440	800	35	11	7	609	568	476	249	109	63
February	140	46	15	4,897	1,050	560	23	9	1	691	584	458	264	105	64
March	94	49	34	3,824	950	980	18	9	5	694	547	402	235	115	79
April	104	33	[a]12	4,260	965	[a]265	20	8	4	670	546	408	268	107	84
May	95	32	54	3,145	640	1,175	19	11	22	632	529	391	221	123	96
June	124	25	37	3,402	1,030	1,155	23	4	3	433	518	399	66	113	85
July	54	33	31	1,208	850	945	9	14	2	414	516	413	45	108	91
August	71	36	50	1,385	1,095	1,665	25	9	.....	402	525	405	38	103	109
September	48	20	31	1,365	653	1,565	7	6	4	419	519	422	48	104	89
October	75	20	38	3,250	650	745	10	3	23	464	523	403	93	117	92
November	75	35	65	2,295	1,765	2,650	15	1	1	499	468	423	116	87	80
December	68	50	[a]14	2,200	1,755	[a]560	5	17	3	499	481	421	110	79	77
Total	1,116	422	398	[b]3,024	[b]1,070	[b]1,089	209	102	75	[b]536	[b]527	[b]418	[b]146	[b]106	[b]84

[a] Kern county not included.

[b] Average.

Well record in California in 1904, by counties.

County.	Wells operated.		Wells drilled.	Wells drilling.	Wells abandoned.	Rigs up, December, 1904.
	Shut in.	Producing.				
Fresno	11	148	57	47	7	18
Kern	417	739	198	33	48	11
Los Angeles	152	1,273	148	35	99	9
Orange	21	131	26	22	9	2
Santa Barbara	30	219	10	21	58	13
Ventura	14	251	10	5	29	1
San Mateo	....	8	5	2	....	2
Santa Clara	2	3	4	2	2	1
Total	647	2,772	458	167	252	57

PHYSICAL PROPERTIES OF CALIFORNIA PETROLEUM.

The following table, giving maximum, minimum, and average gravities, Baumé, 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	......	......	......	......	......	......

ALASKA.

There was no development of petroleum in commercial quantities in any of the Alaska fields during 1904, although a number of wells were drilled, and there were abundant surface showings of both petroleum and natural gas.

There are 4 known localities in which these indications are found, beginning with Cape Yaktag, west of Mount St. Elias. About 100 miles west of Mount St. Elias the Kayak, or Controller Bay, field is located, and it is also about 25 miles southeast of the mouth of the Copper River. The Cook Inlet field is near the western shore of the inlet. The Cold Bay field is located near the point where the Alaska Peninsula leaves the mainland.

There are remarkable surface showings in the way of seepages, springs, and pools of petroleum and of springs or flows of natural gas in all 4 of the districts named, but especially in the Controller Bay district. The Cook Inlet district is about 320 miles west of the Controller Bay district, and the Cold Bay district is about 160 miles southwest of the Cook Inlet district. Up to the close of 1904 about 20 wells had been started, many of which failed to reach a depth of 500 feet, owing to difficulty in drilling in inclined strata. One well was drilled to a depth of 1,700 feet. Of the total number 15 were drilled in the Controller Bay district. There were 6 wells drilled by the Alaska Steam Coal and Petroleum Company, none of them being over 600 feet in depth. Petroleum is reported to have been found in small quantities in 4 of them. In several of these wells there was a considerable showing of petroleum and natural gas, yet their entire production was but a few barrels.

The petroleum produced is of a superior quality, generally of a paraffin base, and some of it closely resembles Pennsylvania petroleum.

Dr. George C. Martin again, in 1904, visited the petroleum and coal fields at Controller Bay, Cook Inlet, and Cold Bay, and found the general structural conditions of the Controller Bay district to include a complex series of semimetamorphosed beds, some petroleum-bearing shales, a succession of coal measures, a series of Miocene sandstone conglomerates and shales, a few igneous rocks, and a large area of alluvial and glacial deposits. Petroleum seepages are very abundant in the Controller Bay region. Those which are best known are situated about 4 miles east of Katalla. The flow of oil here is very large, and good-sized pools have collected on the surface. Another group of seepages is on the headwaters of Burls Creek, where the petroleum may be seen oozing from the joints and bedding planes of the carbonaceous shales and volcanic ash beds which are exposed in the deep ravines. The quantity of petroleum here showing is not so large as at the seepages east of Katalla, but it is more widespread. The small stream between Burls Creek and Bering River has several seepages along its bank. Seepages occur, too, in other parts of the peninsula between Bering Lake and Controller Bay, and in the region west of Katalla. The so-called "Nitchawak region," which is situated on the banks of the various branches of the Nitchawak River and in the vicinity of Mount Nitchawak, also presents a number of seepages. Some of these are located on the banks of a small lake, which is reported to be at times covered with petroleum. The small creeks which enter the Little Nitchawak River from the north have a number of seepages on their banks, in some of which oil issues directly from the rock, which is here a shale. The canyon north of Lone Baldy Mountain and between it and Ragged Mountain contains a number of seepages, in which the oil may be seen oozing from the cracks of the rock.

A strong flow of gas bubbles to the surface of the water at a number of places along the lower course of the Katalla River. In places this flow is so strong that it can be heard for a distance of several hundred feet. The composition of the gas is not known. Several large sulphur springs issue from the northern bank of the Bering River within a mile on either side of the Indian village.

Most of the seepages between Katalla and Bering River fall approximately on three straight lines, each having a general northeast-southwest direction. These lines are nearly parallel to the strike in their vicinity, and are undoubtedly influenced in position and direction by the structure. They probably represent the outcrops of oil-bearing strata. The easternmost of them is on the western flank but very close to the crest of the Chilkat Creek anticline. The westernmost is on the eastern flank and about halfway down the Katalla anticline. Those in the valley of Burls Creek are in a less certain structural position.

The gas springs on the banks of the Katalla River are probably located on or near the crest of the Katalla anticline.

The several field occurrences of petroleum in seepages and their geological relations are more fully discussed under the title of "The Petroleum Fields of the Pacific coast of Alaska,"[a] by Doctor Martin.

Shipments of crude and refined petroleum to Alaska from the United States in the years 1903 and 1904.

[Gallons.]

Kind of oil.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
Crude	1,848,000	$64,000	2,016,430	$69,426
Naphtha	294,923	51,885	338,281	67,718
Illuminating	368,841	77,163	474,615	91,590
Lubricating	28,181	11,275	48,696	18,276
Total	2,539,945	204,323	2,878,022	247,010

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

[a] Bull. U. S. Geol. Survey, No. 250, 1905; see also Bull. U. S. Geol. Survey, No. 259, 1905.

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 3¼ cents per gallon, or $1.35 per barrel, and as 3¼ barrels of petroleum is equal to 1 ton of this 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 following table shows that there were 440,000 barrels of crude petroleum for fuel purposes shipped from San Francisco to the Hawaiian Islands in 1904:

Exports of crude and refined petroleum to Hawaii from the United States in the years 1903 and 1904.

[Gallons.]

Kind of oil.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
Crude	21,858,588	$726,974	18,470,010	$640,957
Naphtha	262,682	33,412	243,063	29,709
Illuminating	1,372,570	203,803	1,015,828	168,490
Lubricating and paraffin	131,445	50,232	139,640	52,658
Total	23,625,285	1,014,421	19,868,541	891,814

PORTO RICO.

The following table shows the variety, quantity, and value of the petroleum products exported from the United States to Porto Rico in 1902, 1903, and 1904:

Exports of refined mineral oils from the United States to Porto Rico in the years 1902, 1903, and 1904.

[Gallons.]

Kind of oil.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Naphtha	16,895	$2,264	3,463	$602	14,515	$2,073
Illuminating	912,501	90,259	1,063,041	123,947	1,096,751	132,656
Lubricating	75,195	25,060	98,520	15,432	117,702	23,185
Total	1,004,591	117,583	1,165,024	139,981	1,228,968	157,914

FOREIGN COUNTRIES OF THE WESTERN HEMISPHERE.

CANADA.

Although there are a number of localities in Canada in which petroleum is known to exist, extending from Newfoundland to the Pacific coast, in Newfoundland and in the provinces of New Brunswick, Quebec, Nova Scotia, Cape Breton, Alberta, and British Columbia, the main supply continues to come from Lamberton County, Ontario.

The new Leamington field produced 25,241 barrels in 1904, which was an increase of about 24,000 barrels over that of 1903. This field is located near the former natural gas field in the southeastern portion of Essex County. The Moore field is noted for the first time with a production of nearly 37,000 barrels, and is located in Moore Township, Lamberton County, which county produced 85 per cent of the total output of petroleum in Canada. There were several new wells drilled in the New Brunswick field that were productive of a lubricating petroleum. A well producing 12 barrels of petroleum per day was drilled in southern Alberta, near South Kootenai Pass.

There are numerous natural showings of petroleum and natural gas on the eastern flank of the Rocky Mountains, extending from the United States line to the Arctic Ocean, which in the future will, in all probability, produce large quantities of petroleum.

One of the most important events in the history of petroleum production in Canada was the passing of an act by the Canadian government, June 8, 1904, reducing the duty on refined petroleum from 5 cents per imperial gallon to 2½ cents, and at the same time crude petroleum, which formerly paid 5 cents per imperial gallon duty, was put on the free list: and the government also agreed to give a bounty of $1\frac{1}{2}$ cents per imperial gallon, amounting to $52\frac{1}{2}$ cents per barrel, on all crude produced, which has resulted in increasing the price paid the producer about $12\frac{1}{2}$ cents per barrel.

For the last three years there have been active operations in New Brunswick near Mamramcook, a few miles south of Moncton, by the New Brunswick Petroleum Company.

There are two fields now being operated 4 or 5 miles apart, known as the Dover and the St. Joseph's College. In both of these fields there have been about 65 wells recently completed, 30 of which were completed in the Dover field and 35 in the original St. Joseph's College field. During 1904 from 18 to 25 of these wells were pumped in each of the fields, most of the production being from 30 wells, and amounting to about 50 barrels per day. There is considerable variation in the depths of the wells. They vary from 300 to 500 feet. Many of them have been torpedoed. The petroleum is found in a rather close sand rock.

There are two varieties of petroleum produced, one quite black and the other dark green. The gravity is nearly the same, from 35° to 37° Baumé, and the petroleum probably of a paraffin base. A refinery has been commenced. Very little has been marketed.

PRODUCTION IN CANADA.

The following is a statement of the production of crude petroleum in Canada for the years 1898 to 1904, inclusive, by districts:

Production of crude petroleum in Canada, 1898–1904, by districts.

[Barrels of 35 imperial gallons, or about 42 standard gallons.]

District.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Petrolia	513,179	a528,641	541,435	432,906	397,628	350,390	278,299
Oil Springs	133,366	b107,487	99,019	76,059	60,747	56,405	75,530
Bothwell	66,404	65,044	47,405	52,873	50,141	48,880	47,654
Moore							36,971
Leamington						1,190	25,241
Dutton		3,622	4,791	10,588	8,867	21,483	14,217
Thamesville							5,027
Wheatley						1,995	4,490
Raleigh					2,462	1,161	3,274
Plympton	25,000						
Dawn	5,923						
Euphemia	5,227						
Zone	901						
Pelee Island							1,023
Blytheswood							669
Comber							97
Total	750,000	704,794	692,650	572,416	519,845	481,504	492,492

[a] Includes the production from Plympton.
[b] Includes the production from Dawn, Euphemia, and Zone.

MEXICO.

Thus far only a limited quantity of petroleum is produced in Mexico, although numerous companies have developed petroleum. The scarcity of coal and the heavy Government tax, amounting to about $4.35 per barrel on crude petroleum and about $9.50 per barrel on refined products, are incentives to find it within the borders of the Republic.

There are numerous seepages and showings of petroleum back on the main land and along the coast line of the Gulf of Mexico reaching from the extreme northeastern portion of the State of Tamaulipas to Yucatan. They are especially numerous north of Tampico, along the coast and extending west 50 miles to the foothills of the mountains. Numerous surface indications are also reported in the States of Oaxaca and Chiapas. The petroleum is generally of a heavy gravity and black in color. The most successful operation at this date is in the State of Tamaulipas, 50 miles west of Tampico, operated by the Mexican Petroleum Company, where about 15 wells have been drilled and petroleum found at about 800 feet. Recently some of these wells have been drilled deeper, and at about 1,700 feet a lighter gravity petroleum was found, reported to have an output of 1,000 barrels per day. A number of large iron tanks have been erected at this locality, and a refinery operated which produces asphaltum chiefly. In the State of Vera Cruz several wells have produced petroleum in limited quantities. Prospecting is still going on.

There are good showings of petroleum in the San Juan Bautista district, State of Tabasco. Farther northeast, in the State of Campeachy, there are seeps and springs from which a superior quality of petroleum has been taken. The National Tehuantepec Railway has drilled a number of wells and in some of them found petroleum; and the company has arranged to drill some of them deeper, hoping for a larger flow of lighter gravity. There seems to be little doubt that this Republic will in the near future produce considerable fuel petroleum, which will in part replace the coal that is imported and the crude produced in Texas that is now used on some of the locomotives for fuel.

The large percentage of crude petroleum imported into Mexico is owing to the small duty on that variety.

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 about 40 per cent of the quantity imported from the United States during 1904. Details of the varied conditions of the industry have been discussed in previous reports.

There are works at Talara and Zorritos. The fuel petroleum produced at Talara is exported into Chile and there used as fuel on the salt-hauling railroad of Tarapaca.

There were 12,270 tons or 73,500 barrels of crude petroleum reported as having been exported from Talara in northern Peru into Chile, replacing the coal that was formerly imported.

The following statement of the production of petroleum in 1904, 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 2,080,000 gallons; of refined, 365,000 gallons; and of benzine and gasoline, 46,200 gallons.

Production of petroleum in Zorritos oil field of Peru, 1896–1904.

[Gallons.]

Year.	Crude petroleum.	Refined.	Lubricating oil.	Benzine and gasoline.
1896	1,996,520	608,900	896,450	4,560
1897	2,874,980	959,645	964,680	7,940
1898	2,880,000	600,000	1,250,000	8,350
1899	3,745,000	806,900	2,541,000	11,220
1900	4,325,000	[a] 400,000	....	13,000
1901	3,135,000	[a] 282,430	....	19,060
1902	2,489,500	[a] 373,250	....	25,920
1903	2,060,000	[a] 276,100	....	61,745
1904	2,080,000	[a] 365,000	....	46,200

[a] Kerosene.

FOREIGN COUNTRIES OF THE EASTERN HEMISPHERE.

RUSSIA.

OPERATIONS IN 1904.

The total production in Russia during 1904 was 78,500,905 barrels, an increase over that of 1903 amounting to 2,909,649 barrels. There was a decline in the production for the two years previous to 1904 amounting to over 4,500,000 barrels per year. Nearly 94 per cent of this decline came from a limited area near Baku on the Caspian Sea. Near the close of 1904 there was a disastrous strike and an oil fire of incendiary origin, which made the production for December nearly 4,500,000 barrels less than that of November. The strike which had for some time interfered with active operations occurred on December 26, and continued until after New Year's. In the meantime 129 rigs, mostly producing wells, were destroyed, involving an immense loss of structures and of crude petroleum.

There were 239 wells completed in 1904 at an average depth of 1,260 feet, whose average production was 384 barrels per day. In 1903 there were only 189 wells drilled to an average depth of 1,296 feet, whose average production was 317 barrels per day. The falling off of the production of the flowing or spouting wells amounted to but 5½ per cent of the production in 1904 as compared with 9 per cent in 1903. There were 1,555 producing wells that at times produced petroleum in 1904. At the close of the year there were also 1,443 wells standing idle; in addition 327 were being cleaned out and repaired; 279 more were being drilled; 66 were being drilled deeper; and 31 were trial pumping wells.

The total quantity of petroleum exported was almost identical with that of the previous year, but considerably less than in 1902. There is therefore a large accumulation of refined products, mostly kerosene, at Batoum. Of the refined products Russia only consumed 5,780,000 barrels. On the other hand, the consumption of fuel oil or mazoot, which is crude petroleum from which a small percentage of the lighter products has been removed by distillation, amounted to nearly 35,000,000 barrels. There was a general increase in 1904 in the price of crude and refined products, amounting to about 40 per cent over that of 1903. However, the question of prices can not always be relied upon, as there are constant sales at less than the price quoted as current.

The market was generally depressed throughout the year. One of the depressing effects during 1904 was the large increase in the production of crude petroleum in the United States and the decline in the price of export petroleum. The internal troubles in Russia and the increased demands by laborers have caused a general depression in business, which has had its effect in the petroleum district. Owing to the great demand for Russian petroleum for liquid fuel, nearly 50 per cent of the production is consumed for that purpose.

The Grosni field, which has produced for several years, showed a considerable increase in production in 1904 over 1903. The new Berekei field, 170 miles north of Baku, mentioned last year, has developed a flow of hot salt water, which has interfered with the producing wells, and the outlook is rather discouraging.

There are indications of the possibility of the island of Tcheleken becoming an important factor in the petroleum world. Most of the preliminary work has been completed, and there are already many reports of oil strikes in different parts of the island. Messrs. Nobel Brothers have begun to erect four large iron tanks, and the equipment of the electric central of this company has been advanced so far that it will be soon completed. The company sent several wagon loads of paraffin prepared from Tcheleken oil to St. Petersburg, and the quality is considered excellent by consumers.

During the last two years petroleum has been found in wells recently drilled in the western portion of Turkestan, Central Asia, province of Ferghana, district of Tehimion. The quality is shown by analysis of Mr. Rojosine to be midway between American and Russian crudes. The specific gravity is 87; equal to 31° Baumé.

The island of Sakhalin 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 suggests 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.

PRODUCTION IN RUSSIA.

Production of crude petroleum in Russia in 1903 and 1904, by fields.

Field.	1903.		1904.	
	Poods.	*Barrels.*	*Poods.*	*Barrels.*
Baku	596,581,155	71,618,386	614,115,445	73,723,290
Grosni	33,094,000	3,972,870	39,797,095	4,777,615
Total	629,675,155	75,591,256	653,912,540	78,500,905

Total production of crude petroleum in Russia, 1897–1904.

[Barrels of 42 gallons.]

Year.	Baku.	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
1904	73,723,290	4,777,615	78,500,905

Comparative production of crude petroleum of Russia and the United States, 1894–1904.

[Barrels of 42 gallons.]

Year.	Russia.			United States.			Production of Russia in percentage of production of United States.
	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
1904	78,500,905	+2,909,649	+ 3.85	117,063,421	+16,602,084	+16.52	67.06

Percentages of world's production of petroleum in 1901, 1902, 1903, and 1904, by countries.

	1901.	1902.	1903.	1904.
Percentage of total crude petroleum produced by Russia	51.49	43.50	38.73	35.82
Percentage of total crude petroleum produced by the United States	41.97	47.94	51.46	53.42
Percentage of all other countries producing petroleum	6.54	8.56	9.81	10.76
Total	100.00	100.00	100.00	100.00

AUSTRIA-HUNGARY.

PRODUCTION.

The production of petroleum in Galicia in 1904 was 827,117 tons, or 5,947,383 barrels, as compared with 5,234,475 barrels in 1903, a gain of 712,908 barrels.

The remarkable production of the deep wells near Boryslaw has furnished a large percentage of Galicia's increased production, which has more than doubled in the last four years.

Boryslaw has long been noted for the production of ozocerite or natural paraffin, which is mined by shafts. There were previously a number of wells producing petroleum in the vicinity, but their capacity was small. During 1902 a test well was drilled to over 900 meters, which began spouting at the rate of 3,000 barrels per day. A rapid development soon followed, and numerous large producers at the increased depth were secured.

During the latter portion of 1904 there was considerable falling off in the production of this field, which was more than made good by the discovery of the new pool near by, called Tustanowice, 3 miles distant, in which are also deep wells that show quantities similar to the original wells in the Boryslaw pool. Nearly all of these wells flow naturally.

One new pool was opened in 1904, known as the Rozi field, not far from Rowne. The first well in this field tapped the producing sand at 859 meters in October, 1902, and at the close of 1904 had produced about 10,000 tons. Well No. 2 was drilled in October, 1903, and by the close of 1904 had produced 10,660 tons; well No. 3 was struck in April, 1904, and by the close of the year had produced 6,425 tons; well No. 4 was a large producer, and struck the pay in June, 1904, at 922 meters, and began to produce at a remarkable rate. This well at the close of the year had placed 29,527 tons, or 175,000 barrels, in tanks to its credit. The outlook for 1905 is very promising for this new field, as there were 46 drilling wells at the close of 1904.

There was a total of 294 wells drilled and drilling in Galicia in 1904, and 47 wells were abandoned, most of them permanently, making 341 operations. The average depth was about 800 meters. Thirty-three wells were drilled to more than 1,000 meters, 2 to over 1,100 meters, and 1 deep well was drilled over 1,200 meters.

Nearly all the wells are drilled in Galicia by the Canadian rod method. A few used the water flush system, and one was drilled by the Wolski hydraulic boring ram. The additional cost of the latter system does not compensate for the time saved over the Canadian system.

The production of the wells varies greatly with their age and the general character of the field. The largest productive well in 1904 was in the old district of Potok, which produced nearly 46,000 tons during the year.

The stocks of petroleum at the beginning of 1904 were 202,816 tons, to which there were added 222,251 tons during the year, making 425,067 tons, about 2,600,000 barrels, on hand at the close of 1904, an increase of 109 per cent. Of this total 40 per cent is held in tanks at Boryslaw.

The Petrolea Company was recently organized to erect tanks and store petroleum, and now owns 37 iron tanks, with a capacity of 157,250 tons. There are also numerous tanks erected at many of the producing fields and at railway shipping points.

Two new pipe lines were built from the new field of Tustanowice to the railway at Boryslaw, and another from Wielopole to Zagorz during the year.

The average price per metric centner in 1904 was 2.55 florins, as compared with 2.82 florins per metric centner in 1903, a decrease of about 10 per cent.

During 1904 no less than 328,000 tons of refined oil resulted from the operations at the refineries, as against 294,000 tons in 1903 and 272,000 tons the preceding year. This increase has naturally been disposed of in the export trade, for, as is well known, the home demand for kerosene can not be extended to any material degree. In the export trade the figures for 1904, when compared with those of 1903, show an increase of about 80 per cent. The present total number of refineries in operation is 90, of which 54 are situated in Galicia and the rest in other parts of the Austro-Hungarian Monarchy. Therefore the quantity of oil refined by many of the Galician refineries is comparatively small.

The data given in the following tables show the development of the Galician petroleum industry.

The statistical bureau of the Petrolea has published the following figures of the crude oil production in Galicia in 1904 (in metric tons):

Crude petroleum production and stocks in Galicia in 1904, by districts.

[Metric tons.]

Locality.	Production.	Quantities forwarded.		Fuel consumption and waste.	Stocks.			
					On Jan. 1, 1904.	On Dec. 31, 1904.		
		Petrolea.	Outsiders.			Petrolea.	Outsiders.	At wells.
Western Galicia:								
Potok	22,864	10,457	19,367	....	11,784	4,557	267	....
Rogi	47,531	35,483	737	245	40	11,106	....	....
Równe	2,455	2,734	38	22	511	172	....	....
Tarnawa-Wielopole	10,708	9,335	894	....	....	112	367	....
Krosno	48,228	29,144	15,332	....	626	4,378	....	....
Other localities	34,441	3,061	27,429	1,250	6,109	331	8,479	....
Total	166,227	90,214	63,797	1,517	19,070	20,656	9,113	....
Eastern Galicia:								
Boryslaw	546,018	225,896	121,856	19,200	162,149	324,566	6,449	10,200
Schodnica	72,627	42,325	12,689	2,227	12,961	24,635	3,712	....
Urycz	27,421	18,851	1,503	341	17,969	21,228	467	....
Mraźnica	4,915	1,446	4,702	484	2,203	100	386	....
Other localities	9,909	284	8,536	1,090	463	....	462	....
Total	660,890	288,802	149,286	23,342	195,745	370,529	11,476	10,200
Western and eastern Galicia together	827,117	379,016	213,083	24,859	214,815	391,185	20,589	10,200

The predominating part of the production still belongs to Boryslaw, which last year contributed 66 per cent of the total. Then follows the still productive Schodnica. In the third rank comes Rogi, where the total production, properly speaking, is obtained from four wells of the Actiengesellschaft für Naphta Industrie. Under the collective name of Krosno in this table are included the Weglowka, Kryg, Humniska, Kobylanka, and Lipinki fields, situated in that district, while other localities in west Galicia include the districts of Wankowa, Harklowa, Wojtowa, Spas, and Paszowa.

Crude petroleum production in Galicia in 1904, by districts and months.

[Metric centners.]

Locality.	January.	February.	March.	April.	May.	June.
Western Galicia:						
Potok	20,050	19,840	21,636	20,670	20,912	20,857
Rogi	13,600	11,725	13,100	14,500	25,975	82,700
Równe	2,606	2,738	2,877	2,207	2,383	2,381
Tarnawa-Wielopole	1,519	1,495	1,765	2,105	3,603	3,688
Krosno	44,169	40,742	34,206	38,345	42,452	42,655
Übrige Gruben	30,617	30,178	30,526	30,350	31,130	30,710
Eastern Galicia:						
Boryslaw	464,288	465,336	464,755	434,244	435,897	453,780
Schodnica	59,061	61,247	65,336	61,169	60,505	58,928
Urycz	19,515	24,502	23,907	23,857	19,625	21,338
Mraźnica	5,050	5,050	5,050	4,050	4,250	3,700
Übrige Gruben	7,200	7,950	8,850	8,830	9,592	8,392

Locality.	July.	August.	September.	October.	November.	December.
Western Galicia:						
Potok	11,932	18,867	18,195	19,000	17,054	19,628
Rogi	74,550	61,650	53,200	46,800	40,060	37,450
Równe	1,586	1,990	1,721	1,492	1,007	1,559
Tarnawa-Wielopole	9,919	10,773	13,648	11,200	23,140	24,222
Krosno	37,585	36,937	40,502	45,278	39,703	39,710
Übrige Gruben	23,900	24,060	27,030	27,380	30,330	28,200
Eastern Galicia:						
Boryslaw	401,721	432,400	420,066	459,375	451,963	528,350
Schodnica	58,470	66,416	60,100	60,100	59,500	55,441
Urycz	20,032	27,848	26,219	26,150	19,200	22,012
Mraźnica	3,700	3,700	3,700	3,700	3,600	3,600
Übrige Gruben	8,664	8,245	8,397	7,666	7,628	7,680

In the following table is given a statement of the production of crude petroleum in Galicia from 1886 to 1904, inclusive, as ascertained by the statistical bureau of the Galizischer Landes-Petroleum-Verein, Lemberg:

Production of crude petroleum in Galicia, 1886–1904.

Year.	Quantity.		Year.	Quantity.	
	Metric centners.	*Barrels of 42 gallons.*		*Metric centners.*	*Barrels of 42 gallons.*
1886	425,400	305,884	1896	3,397,650	2,443,080
1887	478,176	343,832	1897	3,096,263	2,226,368
1888	648,824	466,537	1898	3,304,510	2,376,108
1889	716,595	515,268	1899	3,216,810	2,313,047
1890	916,504	659,012	1900	3,263,340	2,346,505
1891	877,174	630,732	1901	4,522,000	3,251,544
1892	898,713	646,220	1902	5,760,600	4,142,159
1893	963,312	692,669	1903	7,279,710	5,234,475
1894	1,320,000	949,146	1904	8,271,167	5,947,383
1895	2,020,720	1,452,999			

ROUMANIA.

OPERATIONS IN 1904.

Roumania for the last three or four years has made great strides in the development of its petroleum resources. In the four years ending with 1904, it has doubled its production.

The production of crude petroleum in 1904 was 3,572,625 barrels, as compared with 2,763,117 barrels in 1903, a gain of 809,508 barrels, or 25 per cent. To this may be added 50,000 tons which were consumed under the boilers in operating and drilling wells.

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 base of the Carpathian Mountains causes many minor swells in the strata which follow along their flanks, producing ideal conditions for the accumulation of petroleum over many miles of area within reasonable depth. A considerable portion of the petroleum continues to be raised in shafts or hand-dug wells.

One of the serious conditions which, in a measure, retard production 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 price paid for crude in 1904 was slightly greater than in 1903, amounting on an average to 30 francs per ton. There was a slight decline in the value of the manufactured products marketed during the year.

The district of Prahora continues to be by far the largest productive section in the Kingdom, and in 1904 it produced 91.6 per cent of the total output. The district of Damboritz produced 5 per cent, Buzeo 1.6 per cent, and Bacan 1.4 per cent.

The refineries consumed 391,387 tons of crude and produced 109,510 metric tons of refined illuminating petroleum and 62,218 tons of benzine, which is a much larger proportion of benzine and illuminating petroleum than was secured in former years.

There was an increased consumption of residuum and crude for fuel purposes on locomotives and steamboats on the Danube. The consumption from this source was not less than 50,000 tons during 1904

A considerable proportion of the petroleum produced in Roumania is hoisted out of shafts or pits from 500 to 800 feet in depth. The drilled well is fast taking their place, and there were 1,164 feet of shafts abandoned in 1904, 195 were in preparation, and 744 were productive. Of the drilled wells, 150 were abandoned during 1904, 114 were worked upon, and 224 were productive.

On September 24, 1904, a very remarkable well was drilled in on lot No. 65, Campina, belonging to the Steaua Romana Company. This well, at a depth of 1,150 feet, began to spout furiously out of the 12-inch casing, throwing out petroleum, sand, and stones to a height of from 300 to 350 feet, and inundating a large area around the well. It is estimated to equal 500 wagons of sand, stone, and petroleum. The flood of petroleum went down the highway and was mostly saved by the construction of temporary dams over the ravines. The eruption lasted 16 hours and then ceased, and the well was brought under control and, after being cleaned out, began to flow at the rate of 125 wagons per day. The prospective undeveloped territory of Roumania has lately attracted the attention of foreign capitalists and financiers. German, French, Belgian, Holland, Austrian, and American capitalists are all represented. The Government is interested in the development of the petroleum resources of Roumania, and many millions have been expended in the purchase of foreign fuel in past years.

Many of the tables of production, refining, consumption, and export were published by the Monitor of Petroleum, Bukharest, Roumania, after being prepared by Mr. C. Alimanestiano, director of the department of mines.

PRODUCTION IN ROUMANIA.

The production of the last twelve years was as follows:

Production of crude petroleum in Roumania, 1893–1904.

[Metric tons.]

Year.	Quantity.	Year.	Quantity.
1893	56,600	1899	250,000
1894	64,530	1900	250,000
1895	76,000	1901	270,000
1896	80,000	1902	310,000
1897	110,000	1903	384,302
1898	180,000	1904	496,888

GERMANY.

OPERATIONS IN 1904.

At this writing the complete returns for Germany have not been received covering the entire year 1904.

The quantity reported by most of the companies was 89,606 metric tons, equal to 637,332 barrels, valued at 5,804,000 marks, equal to $1,392,960. It is possible that complete returns will increase the quantity to slightly over 90,000 tons. There was a large gain in the production of 1904 over that of 1903, which latter was 62,680 tons, valued at 4,334,000 marks, owing to the increase in the production near Weitze, in Hanover, which began with 1900, since which date the production has about doubled in quantity. In this field about 60 wells have been drilled, 28 of which are producing. Their depth ranges from 450 to 1,400 feet. The petroleum produced from the deeper wells is considerably lighter in gravity than from wells less than 1,000 feet in depth. The field is troubled with quantities of salt water near the productive horizons, which hampers the successful production of many of the wells. The other productive field is 300 miles southwest, in the province of Alsace, near Pechebroun, and has for many years produced from 140,000 to 150,000 barrels annually. Both of these localities produce mainly a dark, heavy petroleum which varies from 0.93 to 0.95 in specific gravity, or from 20° to 17° Baumé.

Nearly all the crude produced in both of these fields is refined, and produces about 40 per cent of an excellent lubricating petroleum, from 15 to 20 per cent of spindle oil, 5 per cent of dark illuminating petroleum, 6 per cent of light illuminating petroleum, and 5 per cent of heavy benzine. The remainder, about 26 per cent, is asphaltum and loss.

The heavy import duty levied by Germany encourages the development of the home industry. The present import duty on illuminating petroleum is 6 marks per 100 kilograms; on lubricating petroleum it is 10 marks per 100 kilograms; petroleum intended for industrial purposes is duty free, except for the manufacture of lubricating, illuminating petroleum, gas, and that intended for cleaning, refining, or distilling in domestic manufactures and certain products thereof.

There has been a considerable amount of competition to supply Germany with illuminating naphtha and lubricating petroleum between the United States and Russia; lately Galicia, Roumania, and the Dutch East Indies have also marketed an increasing quantity of their manufactured products in Germany. The United States, owing to the superior quality of the illuminating petroleums and the superior organization of distribution, has for a number of years furnished about 70 per cent of the imports. In the year 1904 the United States furnished 71.2 per cent of the imports of petroleum into Germany; Russia, 17 per cent; Austria-Hungary (Galicia), 4.7 per cent; Dutch East India, 4 per cent; Roumania, 2.5 per cent; leaving 0.6 of 1 per cent to be furnished by the other countries.

PRODUCTION IN GERMANY.

The production and value of petroleum in Germany from 1880 to 1904 is shown in the following table:

Production and value of petroleum in Germany, 1880–1904.

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
1904	89,606	637,332	5,804,000	1,392,960

[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	1,053	7,490	1892	12,942	92,051
1881	1,237	8,798	1893	12,609	89,683
1882	2,169	15,427	1894	15,632	111,183
1883	1,198	8,521	1895	15,439	109,812
1884	2,775	19,737	1896	18,883	134,310
1885	3,087	21,956	1897	20,703	147,250
1886	7,696	54,738	1898	23,232	165,237
1887	7,892	56,133	1899	23,554	167,530
1888	9,150	65,080	1900	22,597	160,723
1889	6,532	46,759	1901	19,997	142,230
1890	12,977	92,300	1902	20,205	143,710
1891	12,817	91,162	1903	20,947	148,988

Quantity and value of petroleum products imported into and exported from Germany, 1880–1902.

Year.	Imports.		Exports.	
	Quantity.	Value.	Quantity.	Value.
	Metric tons.	*1,000 marks.*	*Metric tons.*	*1,000 marks.*
1880	143,239	54,222	4,722	2,753
1881	193,453	63,889	5,443	3,242
1882	184,834	56,455	5,162	3,077
1883	208,770	67,357	5,299	3,278
1884	239,732	73,998	4,415	2,482
1885	256,900	75,986	502	208
1886	231,849	61,466	430	175
1887	272,432	67,374	430	168
1888	302,616	92,230	633	280
1889	339,659	90,224	427	167
1890	355,458	83,700	255	110
1891	373,564	77,093	236	98
1892	409,610	73,075	181	66
1893	425,373	66,434	302	140
1894	433,040	58,027	763	270
1895	450,865	76,130	1,366	496
1896	477,869	74,367	1,645	577
1897	516,703	62,402	4,584	1,132
1898	527,415	80,025	3,801	891
1899	536,862	97,109	3,464	1,165
1900	558,662	107,050	3,496	1,355
1901	554,468	....	3,484	....
1902	568,253	....	3,729	....

ITALY.

OPERATIONS.

The center of the petroleum production is at present the Emilia district, and particularly the wells in the valley of the Chero, at Velleia and at Montechino, besides those lately taken up at Raglio, in the valley of the Trebbia. Other localities of the Emilia are also productive.

Another center of production is at Tocco da Casauria (the Abruzzi), in the valley of the Pescara, district of Rome.

The refining takes place particularly at Fiorenzuola d'Arda, in the Province of Piacenza. The production in 1903 was 17,876 barrels, valued at $7.96 per barrel, amounting to $142,298. This high value is due to the fact that a very fair grade of petroleum is produced and that the duties levied by the Kingdom and cities are very high. The duty on petroleum, crude, is 8 lire per quintal; petroleum, refined, 48 lire per quintal; paraffin, 15 lire per quintal. On other goods containing petroleum the duty is established after an analysis made at the time of entry. There is also an octroi duty for each town, which in Rome is 6 lire per quintal, 1 lire being equal to 19.3 cents, and a quintal to 220.46 pounds.

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 and 1904. It is also found in small quantities in Lancashire and Shropshire. 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 has 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 1902 as follows:

Production and value of petroleum in Derbyshire, England, 1886–1902.

Year.	Production.		Value.[a]	
	Tons (2,240 pounds).	Barrels (42 gallons).	Pounds sterling.	Dollars.
1886	43	314	129	627
1887	66	482	99	481
1888	35	256	....	....
1889	30	219	45	219
1890	35	256	52	253
1891	100	731	150	729
1892	218	1,594	409	1,988
1893	260	1,900	488	2,372
1894	49	358	92	448
1895	15	110	28	136
1896	12	88	29	141
1897	12	88	29	141
1898	6	44	14	68
1899	5	37	12	58
1900	....	....	....	....
1901	8	59	19	92
1902	25	184	60	290

[a] Value at wells. £1=$4.86.

SHALE OIL.

This industry has continued, notwithstanding the severe competition from the natural products of the United States and Russia. The combined production of all the shale-oil industry in Scotland and England amounts to about 320,000 barrels of oil and paraffin, besides about 32,000 tons of sulphite of ammonia, annually. The industry has been carefully and scientifically managed; even then the margins of profit for the past ten years have been small. In the following table is given the quantity and value of oil shale produced in Great Britain during the years 1897 to 1904, inclusive:

Quantity and value of oil shale produced in Great Britain, 1897–1904.

[Long tons.]

Country.	1897.		1898.		1899.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	878
Total	2,223,745	555,936	2,137,993	534,498	2,210,824	553,003	2,282,221	627,844

Country.	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
England	....	....	....	....	193	£58	....	....
Scotland	....	....	2,105,953	£500,211	2,009,265	477,200	2,331,885	....
Wales	....	....	1,581	593	144	54	1,177	....
Total	2,354,356	£589,162	2,107,534	500,804	2,009,602	477,312	2,333,062	(a)

a Not yet available.

The quantity and value of oil shale produced in Great Britain from 1873 to 1904 are shown in the following table:

Production of oil shale in the United Kingdom, 1873–1904.

[Long tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
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	386,780	1900	2,282,221	627,844
1885	1,770,413	447,302	1901	2,354,356	589,162
1886	1,728,503	435,963	1902	2,107,534	500,804
1887	1,411,378	355,085	1903	2,009,602	477,312
1888	2,076,469	519,074	1904	2,333,062	(a)

a Not yet available.

DUTCH EAST INDIES, SUMATRA, JAVA, AND BORNEO.

Complete returns for the production of petroleum on these islands are difficult to secure, and the figures must, therefore, be considered as closely approximating the production.

Sumatra has by far the largest production, amounting to about 70 per cent of the entire output of the islands named, a large portion of it being petroleum of a paraffin base. Sumatra also contains the largest refineries. The quantity of petroleum produced and of refined petroleum exported has increased yearly since 1900. This has been accomplished by the development of new fields after the failure of the original fields, which made it necessary to build many miles of pipe lines.

The development in Java has not kept pace with that of Sumatra, and the production has been evenly maintained for a series of years. There are a number of refineries on this island that produce a fair grade of illuminating products.

The island of Borneo largely increased its output in 1904 over that of 1903. There are two varieties of petroleum produced, distinguished as light and heavy crude, and many of the wells are large producers. The two principal fields are Balik Pappan and Sanga-Sanga, situated about 50 miles apart in eastern Borneo at the mouth of the Mahakkam River. A refinery is located at Balik Pappan, the petroleum being conveyed from Sanga-Sanga by water in boats carrying 350 tons. Owing to the wildness of the interior, the dense growth of tropical vegetation, and the lack of skilled labor the development has not been so rapid as it would have been if these conditions had not existed. The petroleum produced in Borneo is chiefly used for fuel, and the refining is principally to secure a percentage of the lighter products contained in the crude, so that it can safely be marketed as fuel. The greater portion is transported to points of storage and consumption by the Shell Transportation Company.

There is usually about 25 per cent of the lighter products removed by distillation, the remaining 75 per cent being marketed as fuel oil.

In the British portion of North Borneo petroleum is found at West Sarawak, in the district of Sadong. Among the smaller islands of this group, extending west for many miles, Timor, Seran, and Celebes contain numerous traces of petroleum and have a limited production.

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 mass 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.

PRODUCTION.

The production of these three islands is estimated as follows for the years 1901, 1902, 1903, and 1904:

Production of petroleum in Sumatra, Java, and Borneo in 1901, 1902, 1903, and 1904.

[Barrels.]

Country.	1901.	1902.	1903.	1904.
Sumatra	3,100,000	4,200,000	4,880,000	5,325,000
Java	615,000	750,000	680,000	868,300
Borneo	460,000	910,000	1,080,000	1,815,000
Total	4,175,000	5,860,000	6,640,000	8,008,300

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, 1902, and 1903:

Production of petroleum in the Dutch East Indies in 1900–1903.

Country.	1900.		1901.	
	Crude.	Refined.	Crude.	Refined.
Borneo ... tons[a]	59,352	...	85,554	24,617
Java ... liters[b]	97,308,800	...	102,797,300	...
Sumatra ... do	...	117,109,600	...	264,320,500

Country.	1902.		1903.	
	Crude.	Refined.	Crude.	Refined.
Borneo ... tons[a]	[c] 84,232	[d] 14,215	105,102	...
Java ... liters[b]	63,182,955	20,290,000	106,244,811	...
Sumatra ... do	...	143,042,630	229,900,893	5,310,765

[a] Metric ton=2,204.6 pounds.
[b] Liter=61.027 cubic inches=0.2642 of a United States gallon. 160 liters=1 United States barrel (approximately).
[c] Includes 82,832 tons "liquid fuel" and 1,400 tons crude oil.
[d] Includes 14,207 tons kerosene and 8 tons "solar distillate."

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. Petroleum is also reported to be found on the islands of Guimaris, Cebu, and Mindanao. The geographical position of these islands, with Borneo on the south and west and Formosa and Japan on the north, all of which produce petroleum, as well as the general similarity of geological conditions, would indicate that it should also be found in the Philippines. The United States furnishes about 55 per cent of the present consumption of petroleum and its products. The remainder is supplied by Russia and the Dutch East Indies.

Imports of petroleum from the United States into the Philippine Islands in the years ending June 30, 1902–1904, by kinds of oil.

[Gallons.]

Kind of oil.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Naphtha	315,100	$27,845	29,000	$5,715	50,210	$9,995
Illuminating oil	1,971,100	166,670	2,803,101	265,624	3,294,020	385,171
Lubricating oil	319,639	40,882	57,006	8,309	102,721	23,717
Total	2,605,839	235,397	2,889,107	279,648	3,446,951	418,883

Quantity and value of refined mineral oils imported from the United States into the Philippine Islands, 1899–1904.

[Gallons.]

Year.	Quantity.	Value.
1899	11,297	$2,870
1900	617,849	65,120
1901	1,312,366	119,571
1902	3,451,903	307,994
1903	3,619,054	423,246
1904	5,981,021	650,805

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 and 1904 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 are saturated with water. The depth of the wells is from 750 to 1,800 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 naturally when the field was new. At present nearly all of the wells are pumped. The life of the average well in some of the fields is not long, as a few weeks or months find the output greatly reduced from the original volume; others decrease more slowly. It requires the constant drilling of new wells and the deepening of others where lower productive strata have been developed to keep up the production in most of the fields.

The petroleum produced in the early history of the development generally came from hand-dug wells, which ranged from 100 to 500 feet in depth. These wells were roughly cribbed with timber as they proceeded downward. A supply of pure air was furnished the workmen at the bottom by means of a peculiar bellows operated from the top. All of the hoisting was done by a cable made of rice straw.

One of the other methods of drilling is known as the "bamboo rig," in which large bamboo poles are spliced and joined together by iron bands and are coiled upon the outside of a large reel or wheel, on the inside of which one or two workmen raise or lower the tools by treading. The tools are of iron, with steel bits, and in the operation of drilling are raised by means of a lever in the upper portion of the derrick or by a walking beam attached to a windlass.

During the last six or eight years the greater portion of the production has been secured by regularly cable-drilled wells, and some wells were drilled by the Canadian rod system. It is rather surprising that the workmen of Japan should so soon have acquired the knowledge that enables them to drill wells where there are serious difficulties encountered, and a very large amount of skill is required to accomplish the end. In several of the fields the improved method of pumping wells in clusters by wire rope and solid connections is used. There are also a number of pipe lines connecting several of the fields with refineries that have been laid and are operated by Japanese workmen. There is, however, a considerable percentage of crude petroleum transported from the points of production to these native refineries in tin and wooden cases on the backs of coolies. The heavy distillate or residuum is also transported in the same manner from the refineries back to the wells, where it is used as fuel. The locomotives in Echigo use residuals and inferior crude petroleum as a fuel, and its use in the crude and residual condition is almost universal in pumping and drilling wells and under the boilers of the pipe lines.

The refineries are quite numerous in Echigo, about forty now being in operation. Some of them are primitive; others are fairly well equipped. The best refinery is that recently erected by the International Oil Company at Naoyetsu. It was built and is operated by Americans, and a superior quality of illuminating and lubricating petroleum is manufactured.

The other refineries are almost entirely in the hands of two powerful native companies, which also control a very large percentage of the production of the crude petroleum. These are known as the Nippon and the Hoden companies. The refineries operated by these two companies produce inferior manufactured products, which find a ready sale at a reduced price, although the flash test of the illuminating petroleum is generally too low for safety. All of the petrolem produced in Echigo is of an asphalt base; hence there can be no paraffin produced. The quality of the crude varies in the different fields to a marked degree. Some of it will produce as much as 65 per cent of illuminating products, the larger portion will produce only from 30 to 40 per cent, and a still poorer grade from the Nütsu field will only give 20 per cent. This lasts finds a market as a fuel oil at Nügata and on the railroad between Naoyetsu and Nügata.

IMPORTATION OF PETROLEUM INTO JAPAN.

Japan imports large quantities of illuminating and lubricating petroleum and naphtha, chiefly from the United States, Russia, and the Dutch East Indies. The imports amounted in 1904 to 81,671,801 gallons, equal to 1,944,543 barrels, valued at 18,201,490 yen, or $9,063,345. The production was about 480,000 barrels of refined products. There are, therefore, over 4 barrels of petroleum products imported to 1 barrel produced.

There is a Government tax amounting to 0.076 yen per gallon on the illuminating petroleum products, and 10 per cent ad valorem on paraffin oils, naphtha, vaseline, and mineral grease. Crude petroleum and paraffin are duty free. The importation from the United States is chiefly in cases; that from Russia is largely in bulk. There are storage tanks at Nagasaki, Yokaichi, Kobe, Osaka, and Yokohama. The storage of case oil is largely in the hands of the Government, which has large warehouses at the principal ports of entry. The influence of the war between Japan and Russia has stimulated the foreign trade and importation, especially that of petroleum products, as the imports for 1904 were much greater than for any previous year.

Production of crude petroleum in the Echigo oil field, Japan, in 1904, by districts.

Field.	Production.		Average price per koku.
	Koku.[a]	Barrels of 42 gallons.	
			Yen.
Ojiya (including Yamaya)	18,919	21,481	5.70
Kubiki	78,625	89,274	5.52
Niitsu	531,196	603,139	2.18
Amaze and vicinity	7,300	8,289	7.70
Higashiyama	327,134	371,439	5.30
Nishiyama (including Kamada and Nagamine)	286,362	325,145	3.58
Total	1,249,536	1,418,767	....

[a] 1 koku=1.135436 barrels.

Record of wells in Echigo oil field in 1904, by districts.

Field.	Producing.	Drilled.	Drilling.
Ojiya	37	7	9
Kubiki	397	35	19
Niitsu	777	276	84
Amaze and vicinity	74	....	....
Higashiyama	391	36	10
Nishiyama	177	14	14
Total	1,853	368	136

Production of petroleum in Japan, 1875–1904.

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	1,065,116	50,793,582	333,346	15,896,706	3,103,286	
1904	[f] 1,249,536	59,588,214				

[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] Production of Echigo.

INDIA.

This country is rapidly increasing its production of petroleum. The output for 1904 was 3,385,468 barrels as compared with 2,510,259 barrels in 1903, an increase of 35 per cent.

Almost the entire production is in two districts in upper Burma, known as the Yengenyat and the Yengenyoung fields. Both of these localities are close to the Irawaddy River. The Yengenyoung field is 300 miles in a northern direction from Rangoon and about 250 feet above the bed of the Irawaddy, although cut by several deep ravines.

It extends for 3 miles in a general northwest and southeast direction and averages a half mile in width. There are about 70 drilled wells producing in this district, and about 100 hand-dug shafts or pits. The drilled wells range from 700 to 1,450 feet in depth. The other district, known as Yengenyat, is 55 miles farther north up the river, and is about three-quarters of a mile to the west of the river. Owing to the scarcity of vegetation the structural conditions of this section are readily determined by the exposures, and a well-marked anticlinal with a gentle dip of from 15° to 20° to the west and of from 60° to 80° in the east is well exposed. This can be traced many miles farther to the north of the producing areas known as the Tangyi Hills by following the axis line or by offsetting to other parallel anticlinals. The Irawaddy River breaks through one of these axis lines between these two fields. The parallel ridges to the east of the Yengenyoung production are known as the Pagan and Gwegys hills, and are marked lines of uplift out of a comparatively level plain.

The geological equivalents of this section are the Miocene and Pliocene divisions of the Tertiary group.

The wells usually encounter a number of sandstones of a bluish color that are from 10 to 60 feet in thickness. They contain many quartz grains and are usually capped by a bluish shale.

As many as twelve separate sands have been found in a single well, but not more than three or four have thus far proved productive.

Many of these wells flow originally as much as from 600 to 1,500 barrels per day, but in the course of time they all become pumping wells, continuing to be productive for from eight to ten years, and gradually diminishing until their production is too small to be profitable. Many of the wells when they have arrived at that condition are drilled deeper, and a second or third pay streak is often developed, which greatly lengthens their productiveness. Over 98 per cent of the production of India comes from these two fields. They have been connected during 1904 by pipe line about 47 miles in length and 6 inches in diameter. From Yengenyoung the crude petroleum is carried in large iron barges to the refinery at Rangoon.

Nearly all the petroleum found in Burma and Assam has a paraffin base. The general average is from 5 to 10 per cent of paraffin. The oil in many cases will chill on the derrick floor at a temperature of 77° F. The general specific gravity of the petroleum in Burma and Assam is from 32° to 38° Baumé; probably 36° is the true average. Besides the usual 5 to 10 per cent of paraffin, from 60 to 70 per cent of inferior illuminating product is secured, which has a general average of about 40° Baumé. A less quantity of a much superior grade of illuminating petroleum could be secured, but it is more profitable to manufacture a larger quantity of an inferior quality. There is from 3 to 5 per cent of heavy naphtha, from 10 to 15 per cent of lubricating petroleum, and from 8 to 10 per cent of residuum obtained. A very superior candle is made from the paraffin.

The entire business in Burma is in the hands of the Burma Oil Company, which has a monopoly of the industry. The Upper Assam field has only really started since the new refinery has been completed by the Assam Oil Company. This is located at Digboi, some 60 miles inland from Dibrugarh, on the Bramapootra River, near the extreme northwestern portion of Upper Assam, where an inferior grade of illuminating petroleum is manufactured, which finds a ready sale and is distributed down the river as far as Gauhati.

There have been 22 wells completed in this field, nearly all of which are producers, but the capacity of the refinery at present is not sufficient to test their output. The oil company here owns 8 square miles of productive territory.

A superior grade of paraffin candle is made at Digboi, which has a much wider range of sale than the other manufactured products.

The following, relative to the Assam and Punjab fields, is taken from a recent bulletin of the Imperial Institute:

Assam.—Petroleum is found in Assam in coal-bearing strata of Eocene age. These are exposed near the foot of Naga Hills to the southwest of the river Bramapootra. There is a line of outcrops on the northwestern slopes of the Tipam Hills, a low range running from north-northeast to south-southwest and intersected by the Dihing River near Jaipur and farther to the southwest by the Disang. Another line of outcrops, known as the Makum coal field, is met with farther to the east, running east-northeast and west-southwest, roughly parallel to and south of the Dihing River. It is intersected by the Tirap, Namdang, Makum, and Dirah rivers, all tributaries of the Dihing, and then sinks below the alluvium near the Tipham Hills. Some 40 miles farther to the southwest the coal and oil bearing strata reappear and are exposed in the beds of the Dikhu, Tanji, and Disa rivers.

Punjab.—Oil-bearing strata are found among the Eocene rocks. There are two lines of outcrop running roughly east and west, one near Rawal Pindi, the other north of Shahpur. The only locality that has been worked to any extent is Gunda or Sudkal, about 23 miles west of Rawal Pindi. Oil wells were first dug in 1861. The principal well yielded at first only 5 gallons a day; on deepening the amount was increased, but it never yielded more than 50 gallons in one day, and in one hundred and ninety-eight days in 1870 only 1,963 gallons were obtained. About 1880 the total annual yield was rather more than 2,000 gallons. In March, 1888, a concession was granted to an American oil refiner, who does not appear, however, to have been very successful. In 1889 the yield was only 2,873 gallons, which appears to be the maximum amount obtained in any one year. A limited supply of oil is yet obtained. It appears to be employed in gas-making at Rawal Pindi.

There are many indications that India will in the future produce a much larger quantity of petroleum than it does at present, as the structural conditions of Assam and Burma are favorable in many localities that have not been sufficiently tested to develop the deposit of crude petroleum that underlies them.

The following is taken from the report of the department of revenue and agriculture of the government of India:

The development of the petroleum resources of Burma and Assam has exceeded the rate of growth in the coal trade. For 1902 the production amounted to nearly 57,000,000 gallons, and then represented a substantial increase on previous years. In 1903 the output rose to nearly 88,000,000 gallons, of which over 85,000,000 gallons were raised in Burma. Though this is far from meeting the total demand in India, the home production has already affected the imports of foreign oil, which have steadily decreased during the past three years from nearly 99,000,000 gallons in 1901–2 to 80,500,000 gallons in 1903–4. The production for Assam has risen from about 1,750,000 gallons in 1902 to 2,500,000 in 1903. In addition to a low-grade burning oil and solid paraffin, petrol is now being manufactured. The exports from Burma of the products of petroleum during the last two years have been—

	To foreign countries.		To Indian ports.		Total.	
	1902–3.	1903–4.	1902–3.	1903–4.	1902–3.	1903–4.
Mineral oil:						
Kerosene ....gallons..	2,080	748,892	17,269,071	34,837,486	17,271,151	35,586,378
Other kinds ....do.....	19,320	25,188	3,435,318	3,210,615	3,454,638	3,235,803
Paraffin wax........cwt..	49,663	34,517	1,807	1,452	51,470	35,969

PRODUCTION.

The following table gives the production of petroleum in India from 1889 to 1904, in imperial gallons reduced to barrels of 42 gallons and in rupees reduced to dollars:

Production and value of petroleum in India, 1889–1904.

Year.	Quantity.		Value.	
	Imperial gallons.	Barrels (42 United States gallons).	Rupees.	Dollars.
1889	3,298,737	94,250	....	....
1890	4,132,287	118,065	282,173	93,681
1891	6,654,570	190,131	362,792	132,782
1892	8,479,943	242,284	363,631	119,271
1893	10,463,908	298,969	771,112	225,165
1894	11,452,649	327,218	1,126,744	276,052
1895	13,003,748	371,536	1,539,231	332,474
1896	15,049,289	429,979	1,789,167	416,876
1897	19,099,648	545,704	2,257,842	508,014
1898	18,973,878	542,110	1,018,461	204,710
1899	32,934,007	940,971	1,885,259	388,363
1900	37,729,211	1,078,264	2,231,325	722,949
1901	50,075,117	1,430,716	3,065,131	993,102
1902	56,607,688	1,617,363	3,267,245	1,058,587
1903	87,859,069	2,510,259	5,315,470	1,722,212
1904	118,491,382	3,385,468	7,109,566	2,303,499

The value of the rupee on January 1, 1885, in United States money was 37.8 cents; 1886, 35.7 cents, 1887, 34.6 cents; 1888, 32.2 cents; 1889, 32.3 cents; 1890, 33.2 cents; 1891, 36.6 cents; 1892, 32.8 cents; 1893, 29.2 cents; 1894, 24.5 cents; 1895, 21.6 cents; 1896, 23.3 cents; 1897, 22.5 cents; 1898, 20.1 cents; 1899, 20.6 cents; 1900, 32.4 cents; 1901, 32.4 cents; 1902, 32.4 cents; 1903, 32.4 cents; 1904, 32.4 cents.

CHINA.

The importation of refined petroleum from the United States into China during 1904 was very materially increased over that of previous years. The quantity imported from Sumatra was also largely increased, while that from Russia has largely decreased during the last three years. There were 41,093,567 gallons of refined petroleum, valued at $4,729,448, exported from the United States to China during 1904. The complete returns for 1904 are not available at the present writing.

China produces only a very limited quantity of petroleum and natural gas associated with salt water, but owing to the great distance of the inland localities only unsatisfactory reports can be secured. For many centuries in the province of Szechuen wells have been drilled by a most primitive and laborious method from 2,500 to 3,000 feet in depth that have produced large quantities of salt brine, and natural gas and petroleum in limited quantities, the natural gas being used extensively as fuel to evaporate the salt brine.

The petroleum obtained from the wells is of four different qualities. The first is of a very light color, and is used in its natural state for burning with refined petroleum in special lamps; the second is of a greenish color, and is less valuable than the first; the third is of a yellow color; and the last is black, very thick, and viscous. The oil first mentioned is also employed by the Chinese for medical purposes for various diseases, especially for skin diseases and rheumatism.

The temperature of the petroleum and salt water, as they come from the wells, is about 250° C., while the temperature of the atmosphere is only about 40° C.

IMPORTS.

Imports of refined mineral oil from the United States into the Chinese Empire, 1890–1904.

[Gallons.]

Year ending June 30—	Naphthas, including all lighter products of distillation.		Illuminating.		Lubricating and heavy paraffin oil.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1890			13,072,000	$1,251,201	2,669	$1,888
1891			27,160,660	2,586,321	20,518	5,339
1892			17,370,600	1,249,215	3,367	1,810
1893			27,874,230	1,808,026	3,825	1,411
1894			40,377,296	2,435,794	9,793	2,842
1895			18,022,800	1,175,173	20,675	6,037
1896			25,694,890	2,158,800	48,322	8,178
1897	250	$40	42,516,120	3,352,935	110,814	18,962
1898	1,250	125	44,324,344	2,839,345	197,958	25,625
1899	1,000	150	22,683,425	1,791,108	185,368	25,307
1900	200	39	32,775,880	3,266,395	480,412	68,616
1901	1,200	235	27,419,929	2,387,972	379,520	56,923
1902	3,000	585	56,702,129	4,759,442	392,428	70,295
1903	15,020	3,130	19,321,930	1,776,393	456,955	86,566
1904	15,000	2,987	40,614,179	4,654,841	464,388	71,670

WORLD'S PRODUCTION.

The following table gives the entire production of crude petroleum in all the known countries for 1902, 1903, and 1904, and under the head of "All other countries" an estimate for all of the smaller countries which are known to produce a limited quantity of petroleum, but from which it was impossible to secure returns.

There is a remarkable increase in all the known countries producing petroleum. In the United States the increased production in the new fields of Kansas, Texas, Louisiana, and California has in the last two years amounted to more than one-half of the crude petroleum of the entire world. The increase in the world's production in 1904 over 1903 was 23,958,990 barrels, equal to 12.3 per cent as compared with a gain of 5.4 per cent in 1903 over 1902 and of 11.7 per cent in 1902 over 1901. The increase in the United States in 1904 over 1903 was 16,602,084 barrels. For the same period in Russia there was an increase of 2,909,649 barrels. There was a notable increase in the production of India, Roumania, and Germany. Of the world's production in 1904 the United States and Russia produced 89.24 per cent; India, Galicia, and Roumania produced 5.89 per cent, leaving 4.87 per cent for all the remaining countries.

This table is one of production only, irrespective of quality and value. The quality of the greater proportion of crude petroleum produced in the United States is superior to any other in the percentage of valuable products secured by distillation:

The following table shows the world's production of crude petroleum in 1902, 1903, and 1904:

World's production of crude petroleum in 1902, 1903, and 1904.

[Barrels of 42 United States gallons.]

Country.	1902.		1903.		1904.	
	Quantity.	Percentage of total.	Quantity.	Percentage of total.	Quantity.	Percentage of total.
United States	88,766,916	47.94	100,461,337	51.46	117,063,421	53.42
Canada	520,000	.28	481,504	.25	492,492	.22
Peru and South American countries	60,000	.03	61,745	.03	66,200	.03
Russia	80,540,045	43.50	75,591,256	38.73	78,500,905	35.82
Galicia	4,142,160	2.24	5,234,475	2.67	5,947,383	2.72
Sumatra, Java, and Borneo	5,860,000	3.17	6,640,000	3.40	8,008,300	3.65
Roumania	2,059,930	1.11	2,763,117	1.42	3,572,625	1.63
India	1,617,363	.87	2,510,259	1.29	3,385,468	1.54
Japan	1,193,000	.64	964,000	.49	1,411,975	.64
Germany	353,675	.20	445,818	.23	637,332	.30
Italy	18,933	.02	20,000	.03	36,400	.03
All other countries [a]	26,000		30,000		40,000	
Total	185,158,022	100.00	195,203,511	100.00	219,162,501	100.00

[a] Includes West Indies, Mexico, Algeria, Egypt, Turkey, Persia, and China.

The following table is compiled upon the assumption that 50 per cent of the refined products was secured from the entire production of the United States in 1903, as compared with 20 per cent of the refined products secured from the Russian production and 25 per cent from the production of all remaining countries; and that 45 per cent was obtained in the United States in 1904, the proportion remaining the same for the other countries.

Approximate production of refined products in the United States, Russia, and all other countries in 1903 and 1904, and the percentages of the same.

Country.	1903.		1904.	
	Quantity.	Proportion.	Quantity.	Proportion.
	United States gallons.	*Per cent.*	*United States gallons.*	*Per cent.*
United States	2,109,688,077	71.6	2,212,498,656	73.1
Russia	634,966,550	21.6	565,407,602	18.7
All other countries	201,084,664	6.8	247,780,840	8.2
Total of all countries	2,945,739,291	100.0	3,025,687,098	100.0

Therefore the United States produced 2.72 barrels of refined products in 1904 for every barrel produced by the remaining countries in the world.

The purest and most valuable crude petroleum continues to be produced in the Appalachian and the Lima-Indiana fields; their refined products are marketed in all portions of the world at higher prices than any other because of their intrinsic worth. A very fair grade of illuminating products is secured in Sumatra, Java, Galicia, Roumania, and India. The Russian products are heavier and of fair quality, but recently their lighter products have been in a great measure a by-product, necessarily removed to enable the great bulk to be marketed as fuel petroleum with a required flash test. The crude produced and marketed in Texas, Louisiana, and California is not usually treated in any way, except to meet the requirements of the countries to which it is exported.

The safe and cheap transportation by pipe lines to the seaboard and thence by tank ships has carried petroleum and its products to all the quarters of the globe, and it is the most universal source of artificial light and is to a considerable extent a source of power and fuel.

NATURAL GAS.[a]

By F. H. Oliphant.

INTRODUCTION.

The following are the most conspicuous features in the production of natural gas in the United States in 1904:

1. The production in 1904 was greater than that of any previous year and was valued at $38,496,760.

2. The increase in 1904 over 1903 was $2,688,900, as compared with an increase of $4,939,997 in 1903 over 1902.

3. Four States, Pennsylvania, West Virginia, Indiana, and Ohio, produced 93.3 per cent of the entire value of natural gas produced in the United States in 1904. Pennsylvania alone produced 47 per cent of the entire value.

4. The approximate quantity of natural gas produced in 1904, at a pressure of 4 ounces to the square inch, was 256,645,000,000 cubic feet, or 6,159,480 tons of 2,000 pounds. If the density remained the same throughout, it would fill a pipe that would encircle the globe at the equator whose diameter should be slightly greater than 50 feet.

5. There was much active work in 1904 in the new fields of central Ohio and southeastern Kansas. In the latter a number of remarkably large wells were developed. A large amount was expended in drilling wells, extending many pipe lines, and piping cities and villages in these States. In West Virginia a large number of new wells of large capacity were drilled and connected to the main lines.

6. The United States produced 99 per cent of the entire known world's production of natural gas.

PRODUCTIVE AREAS.

The known main productive areas of natural gas in the United States are the northeastern portion of the Mississippi Valley and the mid-continental area in southeastern Kansas.

The arches and domes on the west flank of the great Appalachian uplift, reaching from western New York to southern central Kentucky, continue the main sources of supply. The slopes of the great

[a] The tables in this report were compiled by Miss Belle Hill, special agent U. S. Geological Survey, Pittsburg, Pa.

Cincinnati uplift, the former in northwestern Ohio and central Indiana, have been largely productive in the past; the newer field in eastern central Ohio has furnished large quantities. The more recent fields of southeastern Kansas, Indian Territory, and Oklahoma are rapidly coming into prominence as prolific gas as well as petroleum areas. The areas named produced in 1904 over 99 per cent of the total value of all the natural gas in the United States.

Natural gas is also produced in limited quantities in South Dakota, Missouri, Arkansas, Louisiana, Texas, Alabama, Colorado, Wyoming, Utah, California, and Alaska.

In the Appalachian field the main supply comes from the Devonian to the upper Coal Measures, a distance in the vertical scale of nearly 6,000 feet. In northwestern Ohio and central Indiana the main source of supply has previously been the Trenton limestone, now largely depleted, and in central eastern Ohio more recently a large supply has been found in the Clinton limestone of the Silurian period on the eastern flank of the Cincinnati uplift.

The productive area in southeastern Kansas and northern Indian and Oklahoma Territories is located in the westerly dipping sandstones of the lower Coal Measures, immediately above the Mississippian limestone or Mountain limestone.

In Texas, Louisiana, Colorado, Wyoming, South Dakota, and California no attempt has been made to give all of the equivalents for the great mass of newer sedimentary strata which produce natural gas in the great western plains and foothills of the mountain chains west of the Mississippi River, which are chiefly Cretaceous and Tertiary.

GEOLOGICAL HORIZONS PRODUCING NATURAL GAS.

The following table gives the natural-gas horizons in the Appalachian and the Lima-Indiana fields. The equivalent of the horizon producing natural gas in Kansas is also named. Nearly all the formations named as producing natural gas also produce petroleum. The intervals vary considerably in different localities, as they are much less in Kentucky and Tennessee than in West Virginia, Pennsylvania, and New York.

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.

Horizons producing natural gas.

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
	Mahoning Dunkard or first Cow Run sand.	do	485
	Second Dunkard sand	Southwestern Pennsylvania, southeastern Ohio, and West Virginia.	525
Allegheny or lower productive XIII.	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 or Big Lime.	Not productive	1,225
	Keener sand and sandy limestone.	Southeastern Ohio and West Virginia.	1,345
Pocono X	Big Injun, Mountain, or Sub-Olean sand.	Southwestern Pennsylvania, southeastern Ohio, West Virginia, and eastern Kentucky.	1,375
	Squaw sand	do	1,465
	Upper gas sand	Southwestern Pennsylvania	1,535
	Berea or Butler County gas sand.	Southwestern Pennsylvania, southeastern Ohio, West Virginia, and Kentucky.	1,730
Upper Devonian VIII.	Devonian or Ohio shales	New York, Ohio, Pennsylvania, Indiana, and Kentucky.	3,000±
	First or Gantz sand (upper portion 100-foot sand).	Western Pennsylvania, southwestern Ohio, and West Virginia.	1,850
	50-foot sand (lower portion 100-foot sand).	Western Pennsylvania and West Virginia.	1,885
	Second or 30-foot sand	do	2,010
	Gray, Gordon, 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

Horizons producing natural gas—Continued.

Geological equivalent.	Petroleum-producing horizons.	Locality where productive.	Approximate depth below Pittsburg coal.
			Feet.
Lower Devonian VIII.	Speechley sand	Northwestern Pennsylvania	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

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 1891 to 1904, by States:

Approximate value of natural gas produced in the United States, 1891–1904, by States.

State.	1891.	1892.	1893.	1894.	1895.	1896.	1897.
Arkansas	$250	$100	$100	$100	$100	$60	$40
California	30,000	55,000	62,000	60,350	55,000	55,682	50,000
Colorado				12,000	7,000	4,500	4,000
Illinois	6,000	12,988	14,000	15,000	7,500	6,375	5,000
Indiana	3,942,500	4,716,000	5,718,000	5,437,000	5,203,200	5,043,635	5,009,208
Kansas	5,500	40,795	50,000	86,600	112,400	124,750	105,700
Kentucky	38,993	43,175	68,500	89,200	98,700	99,000	90,000
Missouri	1,500	3,775	2,100	4,500	3,500	1,500	500
New York	280,000	216,000	210,000	249,000	241,530	256,000	200,076
Ohio	3,076,325	2,136,000	1,510,000	1,276,100	1,255,700	1,172,400	1,171,777
Pennsylvania	7,834,016	7,376,281	6,488,000	6,279,000	5,852,000	5,528,610	6,242,543
Texas		100	50	50	20		
Utah			500	500	20,000	20,000	15,050
West Virginia	35,000	70,500	123,000	395,000	100,000	640,000	912,528
Other States	250,000	200,000	100,000	50,000	50,000	50,000	20,000
Total[a]	15,500,084	14,870,714	14,346,250	13,954,400	13,006,650	13,002,512	13,826,422

[a] Does not include value of gas produced in Canada and consumed in the United States.

Approximate value of natural gas produced in the United States, 1891–1904, etc.—Cont'd.

State.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Arkansas and Wyoming						$2,460	$6,515
California	$65,337	$86,891	$79,083	$67,602	$120,648	104,521	114,195
Colorado	3,300	1,480	1,800	1,800	1,900	14,140	14,300
Illinois	2,498	2,067	1,700	1,825	1,844	3,310	4,745
Indiana	5,060,969	6,680,370	7,254,539	6,954,566	7,081,344	6,098,364	4,342,409
Indian Territory and Oklahoma					360	1,000	49,665
Kansas	174,640	332,592	356,900	659,173	824,431	1,123,849	1,517,643
Kentucky	103,133	125,745	286,243	270,871	[a] 365,656	[a] 390,601	[a] 322,404
Missouri	145	290	547	1,328	2,154	7,070	6,285
New York	229,078	294,593	335,367	293,232	346,471	493,686	522,575
Ohio	1,488,308	1,866,271	2,178,234	2,147,215	2,355,458	4,479,040	5,315,564
Pennsylvania	6,806,742	8,337,210	10,215,412	12,688,161	14,352,183	16,182,834	18,139,914
South Dakota		3,500	9,817	7,255	10,280	10,775	12,215
Alabama							14,082
Texas	765	8,000	20,000	18,577	14,953	13,851	
Utah	7,875						
West Virginia	1,334,023	2,335,864	2,959,032	3,954,472	5,390,181	6,882,359	8,114,249
Other States	20,000						
Total [b]	15,296,813	20,074,873	23,698,674	27,066,077	30,867,863	35,807,860	38,496,760

[a] Includes small quantity produced in Tennessee; includes also some gas produced in West Virginia, but consumed in Kentucky.
[b] Does not include value of gas produced in Canada and consumed in the United States.

VALUE OF NATURAL GAS AND PETROLEUM AND THEIR COMBINED VALUE IN 1903 AND 1904, BY STATES.

The combined value of natural gas and petroleum in 1904 amounted to $139,667,226, a gain of $9,165,316 when compared with their combined value in 1903. Of this gain $2,688,900 was from natural gas and $6,476,416 from petroleum; hence, of the total value, 72.4 per cent was furnished by petroleum, leaving 27.6 per cent for natural gas in 1904, as compared with 72.6 for petroleum and 27.4 for natural gas in 1903, a remarkable regularity.

The value of the natural gas produced in Kansas in 1903 was greater than that of the petroleum, which was reversed in 1904, as the value of petroleum produced in that year was many times greater than that of the natural gas. The value of the natural gas produced in Pennsylvania in 1904 was almost equal to the value of the petroleum produced in that year. Louisiana produced petroleum, but no value was assigned for the natural gas consumed, and South Dakota and Illinois produced natural gas but no petroleum, although the latter has formerly produced a limited quantity of petroleum.

The following tables give the value of natural gas and of petroleum and their combined value in 1903 and 1904, 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	13,851	7,517,479	7,531,330
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 Territory and Oklahoma	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	3,310	....	3,310
Total	35,807,860	94,694,050	130,501,910

Value of the natural gas and petroleum produced in 1904, and their combined value, by States.

State.	Value of natural gas.	Value of petroleum.	Value of natural gas and petroleum.
Pennsylvania	$18,139,914	$18,507,103	$36,647,017
Ohio	5,315,564	23,730,515	29,046,079
West Virginia	8,114,249	20,583,781	28,698,030
Indiana	4,342,409	12,235,674	16,578,083
California	114,195	8,265,434	8,379,629
Texas and Alabama	14,082	8,156,220	8,170,302
Kansas	1,517,643		
Indian Territory	49,665	5,447,622	7,014,930
Oklahoma			
New York	522,575	1,526,976	2,049,551
Kentucky and Tennessee	322,404	984,938	1,307,342
Louisiana	....	1,068,605	1,068,605
Colorado	14,300	578,035	592,335
Arkansas and Wyoming	6,515	80,794	87,309
South Dakota	12,215	....	12,215
Michigan and Missouri	6,285	4,769	11,054
Illinois	4,745	....	4,745
Total	38,496,760	101,170,466	139,667,226

NUMBER OF COMPANIES REPORTING, VALUE OF NATURAL GAS CONSUMED, AND VALUE OF OTHER FUEL DISPLACED IN 1904, BY STATES.

The first column of the following table gives the number of companies and individuals from whom reports were received in the several States; there were 2,347 who reported in 1904, as compared with 2,329 in 1903. In New York, Pennsylvania, Ohio, and Indiana there are numerous small wells which supply often only one or two families. There has been lately a number of consolidations of larger companies.

The third column shows the estimated value of coal and wood displaced by natural gas in 1904, which amounted to $43,413,240; this is $4,916,480 more than was paid for the natural gas.

The cheaper rates of natural gas in Indiana and Kansas placed the value of the fuel it supplanted at a higher figure than the natural gas. The higher prices of natural gas in New York State was more than offset by the high price of anthracite coal in Buffalo. The general average price of natural gas to the consumers is very close to 16 cents per 1,000 cubic feet at a pressure of 4 ounces above atmosphere. The greater portion of the domestic consumption is furnished at between 18 and 25 cents per 1,000 cubic feet:

Value of natural gas consumed in the United States in 1904, by States, and the value of coal or wood displaced by same, as reported by 2,347 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	$17,205,804	$18,237,920
Ohio	[b] 453	9,393,843	9,938,686
Indiana	846	4,282,409	5,318,752
West Virginia	90	3,383,515	4,780,907
New York	[c] 153	2,222,980	2,262,711
Kansas	190	1,517,643	2,275,875
Kentucky and Tennessee	47	268,564	298,075
California	23	114,195	158,195
Colorado	4	[d] 14,300	12,980
Texas and Alabama	7	14,082	14,082
South Dakota	7	12,215	22,315
Missouri	30	6,285	6,285
Illinois	59	4,745	4,745
Arkansas and Wyoming	4	6,515	7,215
Indian Territory and Oklahoma	20	49,665	74,497
Total	2,347	38,496,760	43,413,240

[a] Includes 127 individual producers in Erie County, the product of whose wells is principally for their own domestic consumption.
[b] Includes 323 individual producers in Ashtabula, Cuyahoga, Lake, and Lorain counties, the product of whose wells is principally for their own domestic consumption.
[c] Includes 91 individual producers in Chautauqua County, the product of whose wells is principally for their own consumption.
[d] Largely used for illuminating purposes.

USES OF NATURAL GAS.

In the following table are specified the uses to which the natural gas produced in the United States in 1904 was put:

Uses to which natural gas produced in the United States in 1904 was put, as reported by 2,347 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	238,481	35	65	89	2,740	2,929
Ohio	453	232,557	3	6	15	1,112	1,136
Indiana	846	84,862	8	4	81	297	390
West Virginia	90	44,563	7	2	32	964	1,005
New York	153	67,203	1		6	444	451
Kansas	190	27,204	6	4	14	274	298
Kentucky	45	11,495	1	1		55	57
Tennessee	2	1				1	1
California	23	3,757				14	14
Colorado	4	372				3	3
Texas	6	221				2	2
South Dakota	7	253				2	2
Missouri	30	181				1	1
Illinois	59	92				2	2
Arkansas	1	96				4	4
Wyoming	3					2	2
Indian Territory and Oklahoma	20	1,239				35	35
Alabama	1					1	1
Total	2,347	712,577	61	82	237	5,953	6,333

There was an increase of but 18 in the companies and individuals reporting in 1904 over 1903, while the number of consumers supplied with natural gas in 1904 increased 85,530 over the previous year. There was a decrease of 889 in the establishments supplied in 1904 compared with 1903. A large proportion of the decrease is due to the diminished pressure and the small supply in the natural-gas fields of Indiana and northwestern Ohio. A number of the iron and steel plants and glass manufactories in Pennsylvania and West Virginia have their own natural-gas plants. During the summer months owing to the light domestic trade it is customary for the natural-gas companies to supply temporarily a number of manufactories. The great bulk of the consumption is for domestic purposes, where it properly belongs because of its particular fitness. There were 712,577 domestic consumers supplied in 1904, an increase of 85,530 over 1903. This increase came chiefly from Ohio, Pennsylvania, Kansas, New York, and West Virginia. Indiana showed a decrease. It is estimated that not less than 4,600,000 individuals were supplied with light and fuel, and not less than 5,000,000 individuals received benefit from 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, 1903, the productive wells drilled during 1904, the wells abandoned in 1904, those producing at the close of 1904, the nonproductive natural-gas wells drilled during 1904, 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 1904. There were 136 more wells producing at the close of 1904 than at the beginning; there were 1,350 miles of pipe laid during 1904.

Record of wells and amount of pipe line, as reported by 2,347 persons, firms, and corporations in 1904, by States.

State.	Companies or individuals reporting.	Wells.					Total pipe laid to Dec. 31, 1904.	
		Producing, Dec. 31, 1903.	Producing, drilled in 1904.	Abandoned in 1904.	Producing, Dec. 31, 1904.	Nonproducing holes drilled in 1904.	Feet.	Miles.
Pennsylvania	414	5,915	701	264	6,352	174	60,434,996	11,446.0
Ohio	453	1,523	334	196	1,661	49	30,579,825	5,791.6
Indiana	846	5,785	706	1,807	4,684	153	27,760,588	5,257.7
West Virginia	90	1,058	292	76	1,274	33	20,787,732	3,937.1
New York	153	707	78	31	754	12	7,899,723	1,496.2
Kansas	190	726	378	75	1,029	135	7,022,852	1,330.1
Kentucky	45	128	27	5	150	4	683,086	129.4
Tennessee	2	2			2		1,000	.2
California	23	42	10	4	48		457,785	86.7
Colorado	4	3			[a]3		82,640	15.7
Texas	6	16	1	1	[a]16		138,078	26.1
South Dakota	7	8	1		9		29,900	5.7
Missouri	30	31	11	2	40	4	71,425	13.5
Illinois	59	46	26	4	68		71,460	13.5
Arkansas	1	2	5		7		90,000	17.0
Wyoming	3	1	5	2	4		17,480	3.3
Indian Territory and Oklahoma	20	8	27		35		327,800	62.1
Alabama	1	1	1		2			
Total	2,347	16,002	2,603	2,467	[b]16,138	564	156,456,370	29,631.9

[a] Gas is produced from oil wells not included in this table.
[b] Includes 283 wells not utilized in 1904.

NATURAL-GAS INDUSTRY IN INDIVIDUAL STATES.

PENNSYLVANIA.

The large increase in the value of the production of natural gas in Pennsylvania in 1904 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. There has been a general decrease in the rock pressure in all of the fields, which has not been made up by the discovery of any new pools of any magnitude during 1904. Otherwise the conditions remain the same as in 1903.

The deep Bayard and other sands in Greene County, the Gordon, the Big Injun, the Fourth and the Fifth sands of Washington and Fayette counties, the Speechley in Butler, Armstrong, and Venango counties, and the deeper underlying sands of Elk, McKean, and Potter counties, have all contributed largely to maintain and even to increase materially the output of Pennsylvania.

Value of natural gas produced in Pennsylvania, 1885–1904.

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	8,337,210
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	1904	18,139,914

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 1901, 1902, 1903, and 1904:

Record of natural-gas industry in Pennsylvania, 1901–1904.

	1901.	1902.	1903.	1904.
Amount received for sale of gas or value of gas consumed	$11,785,996	$13,942,783	$16,060,196	$17,205,804
Value of natural gas produced	$12,688,161	$14,352,183	$16,182,834	$18,139,914
Value of coal and wood displaced	$11,892,070	$17,912,629	$20,075,245	$18,237,920
Domestic consumers supplied	[a] 326,912	185,678	214,432	238,481
Iron and steel works supplied	82	99	96	100
Glass works supplied	80	124	122	89
Other establishments supplied	1,581	2,225	2,616	[b] 2,740
Total establishments supplied	1,743	2,448	2,834	2,929
Total wells producing, Jan. 1	3,776	4,529	5,444	5,915
Total productive wells drilled	660	775	699	701
Total wells abandoned	239	203	228	264
Total wells producing, Dec. 31	4,197	5,101	5,915	[c] 6,352
Total dry holes drilled	143	232	126	174
Total feet of pipe laid to Dec. 31	47,913,618	48,863,621	53,886,301	60,434,996
Number establishments reporting	296	379	414	414

[a] Number domestic fires supplied.
[b] Including 372 iron, steel, and glass works and potteries not subdivided.
[c] Includes 26 wells not used in 1904.

INDIANA.

The value of natural gas produced in Indiana in 1904, compared with 1903, shows a decline of $1,755,955, as compared with a decline of $982,980 in 1903 from 1902. It is rather remarkable that this State should hold up its production in the manner it does, when the falling off in the original rock pressure, which always invites the inflow of salt water and causes the eventual sealing up of the well is considered. At the beginning of the year the general rock pressure in the older field was close to 15 pounds to the square inch; at the close of the year it was reduced to about 5 pounds. Originally it was 350 pounds, and a number of wells discharged as much as 12,000,000 cubic feet per day. Many of the cities and towns as well as manufacturing plants have been forced to abandon natural gas as a fuel and to substitute coal, wood, or manufactured gas, or seek new locations where cheaper fuel is available. Occasionally a fair gas well is found where a limited reservoir has escaped the general depletion, but the lives of such wells are necessarily short, owing to their limited areas.

The great proportion of gas is at present secured while drilling in search of oil. There is hardly any attempt made at drilling for gas exclusively. In fact the general practice in operating for oil is to keep the wells pumped, thus keeping the rock clear of water and getting what oil there is, with a better flow of gas than by leaving the wells to stand and drown out. The bulk of the gas produced in this field to-day is pumped to the point of consumption. In the majority of cases it is considered best to drill into the oil strata, getting all the gas there is, and at the same time to get what oil there is, as for the best results the well must be pumped in any event, as even a shallow gas well will ordinarily accumulate water. The pressure varies in different fields. In many cases where compressors are used the pull creates a suction on the rock. The portion of the territory having no compressing stations depends upon the natural pressure of the rock, and in such instances the rock pressure will be better, as there has been no depletion by reason of the "pull" a compressor will cause.

Many plants have installed producers for making their own gas from coal. It is a general resort all over the gas belt to construct producers and to do away with the natural gas.

There will be gas for private consumption for some years, as a private consumer can use wood to overcome any slight deficiency and can have the assurance of a supply during the warmer months; but in manufacturing the annoyance of a deficient supply can not be endured.

New developments have been made in southern Indiana in 1904, at Princeton and Petersburg. During the year the town of Princeton has been piped and the glass works have been supplied with natural gas from the nearby petroleum field. The rock pressure showed 305 pounds. The glass works consume about 2,000,000 cubic feet daily.

Near Petersburg a new well was completed, three-quarters of a mile west of the original well, which measured 2,000,000 cubic feet per day with a rock pressure of 500 pounds. This village has for several years enjoyed a good supply from a single well.

In the following table will be found a statement of the value of the natural gas produced in Indiana from 1886 to 1904:

Value of natural gas produced in Indiana, 1886–1904.

Year.	Value.	Year.	Value.
1886	$300,000	1896	$5,043,635
1887	600,000	1897	5,009,208
1888	1,320,000	1898	5,060,969
1889	2,075,702	1899	6,680,370
1890	2,302,500	1900	7,254,539
1891	3,942,500	1901	6,954,566
1892	4,716,000	1902	7,081,344
1893	5,718,000	1903	6,098,364
1894	5,437,000	1904	4,342,409
1895	5,203,200		

Record of natural-gas industry in Indiana, 1901–1904.

	1901.	1902.	1903.	1904.
Amount received for sale of gas or value of gas consumed	$6,276,119	$6,710,080	$5,915,367	$4,282,409
Value of natural gas produced	$6,954,566	$7,081,344	$6,098,364	$4,342,409
Value of coal and wood displaced	$10,669,402	$10,066,248	$8,281,515	$5,318,752
Domestic consumers supplied	[a]153,869	101,481	90,118	84,862
Iron and steel works supplied	11	20	23	12
Glass works supplied	111	141	130	81
Other establishments supplied	2,448	3,121	867	297
Total establishments supplied	2,570	3,282	1,020	390
Total wells producing, Jan. 1	4,287	5,371	5,876	5,785
Total productive wells drilled	985	1,331	895	706
Total wells abandoned	700	882	1,257	1,807
Total wells producing, Dec. 31	4,572	5,820	5,514	[b]4,684
Total dry holes drilled	208	205	242	153
Total feet of pipe laid to Dec. 31	31,241,320	36,121,980	34,838,053	27,760,588
Number establishments reporting	656	929	924	846

[a] Number domestic fires supplied. [b] Includes 8 wells not used in 1904.

WEST VIRGINIA.

The value of the natural gas produced in West Virginia continues to increase from year to year, and since 1902 the State has ranked second in the list of gas-producing commonwealths. During the last ten years (from 1894 to 1904) the value has increased nearly 2,000 per cent. For a number of years this State has furnished an immense quantity of natural gas to the cities and towns of southwestern Pennsylvania and Ohio. During 1904 there was a very great increase in the quantity delivered to Ohio. The city of Cleveland, in addition to Toledo, and many other smaller cities in eastern and central Ohio, is now fully supplied with natural gas produced in West Virginia.

The structural conditions over a large area in the northwestern portion of this State are ideal for the accumulation of this most valuable gaseous fuel. 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 Marion, Monongalia, and Calhoun have also furnished many remarkable wells. The counties of Tyler, Ritchie, Doddridge, Marshall, Wood, Pleasants, Wirt, Roane, Boone, Mingo, Kanawha, Logan, and Gilmer have also produced gas wells of greater or less value. The principal sands furnishing natural gas are the Big Injun, Keener, Berea, Gantz, and Fifty foot, Thirty foot, Gordon Stray, Gordon, Fifth, and Bayard sands. These last names are buried from 2,700 to 3,200 feet along the crests of anticlinals, and their rock pressure varies from 800 to 1,250 pounds to the square inch, while their volume ranges from 3,000,000 to 35,000,000 cubic feet per day. The main supply comes from the Big Injun and the Venango groups of sandstone. To the southwest the last prominent uplift of the Appalachian chain of mountains sinks down, and on this declining anticlinal and the next one to the west and parallel to it many of the largest producers in southern Harrison County and in northwestern Lewis County have been secured. The prolific gas field in Wetzel and Tyler counties is due to a prominent anticlinal which passes southwestward near Uniontown, Wetzel County, Kingston, Owls Head Knob, and into Tyler County, terminating south of Indian Creek, on which was located the once famous but now exhausted Big Moses well.

There is a prominent uplift extending from Eureka to Burning Springs nearly north and south, a distance of 40 miles, on whose flanks a great number of fair gas wells have been developed. 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 three 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, thereby enabling a much larger volume to be available when an emergency should require it. The search for petroleum in this State, as in others, has caused an immense loss of the most valuable natural-gas fuel by allowing the gas to exhaust itself in the air. The manufacture of lampblack is extensively developed in Calhoun, Lewis, and Doddridge counties. It is estimated that from 30 to 40 million cubic feet per day are consumed in this most wasteful process.

The structural conditions over such a large area in this State indicate that it will be a source of a vast quantity of natural gas for many years in the future, which will be used to supply the decreasing volume that must necessarily follow the gradual exhaustion of the older fields in Pennsylvania and Ohio. It is probable, too, that in the near future Indiana will be consuming natural gas produced in West Virginia.

Natural gas is the source of fuel or power when exploded in the gas engines used in drilling and pumping the thousands of gas and oil wells and in operating the pumping plants which collect the petroleum and force it through pipe lines to markets beyond the State.

Because of its abundance at present no warrant is given for its extravagant use and wanton waste. The almost complete exhaustion of many of the original fields in Pennsylvania, Ohio, and Indiana bear witness to the fact that the contents of these reservoirs are limited and that every cubic foot removed leaves that much less available. Needless display in torches that are never shut off, and waste in all extravagant methods of combustion, and the practice of drilling oil wells in prolific gas territory should be regulated so as to utilize the large quantity that is so often wasted.

The value of the natural gas produced in West Virginia from 1889 to 1904 is shown in the following table:

Value of natural gas produced in West Virginia, 1889–1904.

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	70,500	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	1904	8,114,249

Record of natural-gas industry in West Virginia, 1901, 1902, 1903, and 1904.

	1901.	1902.	1903.	1904.
Amount received from sale of gas, or value of gas consumed	$2,244,758	$2,473,174	$3,125,061	$3,383,515
Value of natural gas produced	$3,954,472	$5,390,181	$6,882,359	$8,114,249
Value of other fuel displaced	$2,415,360	$2,994,777	$4,375,000	$4,780,907
Domestic consumers supplied	[a] 55,808	29,357	36,179	44,563
Iron and steel works supplied	2	11	9	9
Glass works supplied	13	31	25	32
Other establishments supplied	251	835	1,088	[b] 964
Total establishments supplied	266	877	1,122	1,005
Total wells producing Jan. 1	418	794	903	1,058
Total productive wells drilled	177	142	242	292
Total wells abandoned	51	51	46	76
Total wells producing Dec. 31	544	885	1,099	[c] 1,274
Total dry holes drilled	8	37	43	33
Total feet of pipe laid to Dec. 31	11,852,303	14,548,395	18,224,176	20,787,732
Number establishments reporting	44	79	88	90

[a] Number of domestic fires supplied.
[b] Including 33 iron, steel, and glass works and potteries not subdivided.
[c] Includes 14 wells not used in 1904.

OHIO.

There are a number of natural-gas fields in this State that are widely separated both geographically and geologically. The great volume found in the northwestern portion, which in 1888 and 1890 was at the zenith of its production, has since been greatly depleted, so that instead of the original rock pressure of 425 pounds to the square inch there is in many localities practically no pressure at all. There are natural-gas producing areas of greater or less extent beginning in Noble and Washington counties in the southeastern portion of the State and extending northeast to Columbiana County. In Morgan, Perry, Vinton, and Jackson counties wells producing considerable quantities of natural gas have likewise been found and utilized.

Just east of the central portion of the State, south and east of Lancaster, a large field has been recently developed and heavily drawn upon, until the original rock pressure of 800 pounds to the square inch has now been reduced to about 150 pounds. The pool was first developed by a well drilled near Lancaster in 1887, and a fair flow of natural gas was secured from the Clinton limestone, a horizon which heretofore was considered barren. In 1893 the field was extended to Sugargrove, almost 10 miles due south, and a number of wells were developed with a capacity of from 4 to 12 million cubic feet per day and a rock pressure of 800 pounds.

During 1900 and 1901 a new and prolific field was opened due north of the Lancaster and Sugargrove field, known as the Homer field, about 30 miles north, on the line dividing Licking and Knox counties, in the same Clinton formation. This has proved to be a very extensive and prolific field, especially that portion in Burlington township in Licking County and Miller township in Knox County, where the largest wells have been found. So far as developed, the area is about 22 miles long and from 3 to 6 miles in width; it was considerably extended to the north and east during 1903, and now covers a territory that in whole or in part embraces 30 townships. The average production of the wells drilled is large, and the proportion of dry holes is comparatively small. The largest well produced over 10,000,000 cubic feet per day in 1904. The depth of the wells is from 2,150 to 2,250 feet. This new pool was connected with Columbus by two large pipe lines in 1903.

A new shallow sand natural-gas field was developed in Vinton County in 1904, which contained a number of fair producers. There is a small field producing some gas from the Corniferous limestone located in Ashtabula County. There are a vast number of shallow wells that secure a small but constant flow from the Berea sand and the underlying Ohio shale in western Cuyahoga, eastern Lorain, and northern and central Medina counties.

During the year 1904 Ohio was supplied with an increasing quantity of natural gas from West Virginia, and to a much smaller extent with gas from Pennsylvania, Kentucky, and Indiana.

During 1904 a new gas line 10 inches in diameter was constructed from the central portion of Clarion County, Pa., to Ashtabula, Ohio, a distance of 80 miles, by the Alum Rock Natural Gas Company.

The value of the natural gas produced in Ohio in 1904 was $5,315,564, an increase of 19 per cent over the preceding year. The value of the natural gas consumed in Ohio was $9,393,843, an increase of 30.5 per cent in 1904 over 1903. Of the entire consumption of natural gas in Ohio in 1904, 56.6 per cent was produced within the borders of the State; the remainder, 43.4 per cent, being supplied principally by West Virginia.

The value of the production of natural gas in Ohio in 1904 was the largest in its history, exceeding that of 1889. The quantity actually consumed, however, was probably not one-half of that marketed in 1889, for which $5,215,669 was received, when the new and prolific fields in northwestern Ohio were at their zenith and millions of cubic feet were consumed in extravagant displays or given away and consumed without regard to compensation or economy.

The value of the natural gas produced in Ohio from 1885 to 1904 is shown in the following table:

Value of natural gas produced in Ohio, 1885–1904.

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	1904	5,315,564

Record of natural-gas industry in Ohio, 1901, 1902, 1903, and 1904.

	1901.	1902.	1903.	1904.
Amount received for sale of gas or value of gas consumed	$4,119,059	$4,785,766	$7,200,867	$9,393,843
Value of natural gas produced	$2,147,215	$2,355,458	$4,479,040	$5,315,564
Value of coal and wood displaced	$4,448,584	$5,351,878	$8,155,570	$9,938,686
Domestic consumers supplied	a 149,709	120,127	197,710	232,557
Iron and steel works supplied	6	17	19	9
Glass works supplied	13	56	63	15
Other establishments supplied	930	713	1,704	b 1,112
Total establishments supplied	949	786	1,786	1,136
Total wells producing Jan. 1	885	1,099	1,343	1,523
Total productive wells drilled	113	266	290	334
Total wells abandoned	48	75	110	196
Total wells producing Dec. 31	950	1,290	1,523	c 1,661
Total dry holes drilled	35	40	62	49
Total feet of pipe laid to Dec. 31	15,199,295	20,093,670	27,876,583	30,579,825
Number of establishments reporting	305	451	515	453

a Number domestic fires supplied.
b Including 107 iron, steel, and glass works and potteries not subdivided.
c Includes 29 wells shut in in 1904.

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 Erie County field and the neighborhood of Wellsville and Ricebrook, in Allegany County, from the sands found in the Upper Devonian. There are a vast number of wells scattered along the south shore of Lake Ontario and many wells along the south shore of Lake Erie that furnish from one to four families with gas. The town of Fredonia, Chautauqua County, 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. During 1904, by deeper drilling, seven very fair natural-gas wells were found near Silver Creek, in this county. At a depth of 1,750 feet the red Medina sand was struck, which with the white Medina was 55 feet in thickness and produced a gas well that started off at about 1,000,000 cubic feet; this product was utilized at Silver Creek, Forestville, and Dunkirk. Two wells were drilled at Brockton, which found the Medina sand at about 2,225 feet and which gave a flow of about 10,000 cubic feet only. Considerable pockets of natural gas highly charged with sulphureted hydrogen were found at 400 and 600 feet in the Devonian slate.

There is a natural-gas field of considerable extent in Erie County, east of Buffalo, near the Genesee County line, where the Medina is also productive.

The counties producing natural gas in New York are Allegany, Cattaraugus, Chautauqua, Erie, Livingston, Niagara, Onondaga, Oswego, Seneca, and Wyoming. The last three years have shown an increase in annual production. The value of the natural gas produced in 1904 was only about 24 per cent of the value of the natural gas consumed, the 76 per cent being supplied by Pennsylvania, and to a small extent by Canada; the gas from the latter source was consumed in Buffalo.

The value of natural gas produced in New York from 1885 to 1904, inclusive, is given in the following table:

Value of natural gas produced in New York, 1885–1904.

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	1904	522,575

[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, 1901, 1902, 1903, and 1904.

	1901.	1902.	1903.	1904.
Amount received for sale of gas or value of gas consumed	$1,694,925	$1,723,709	$1,941,667	$2,222,980
Value of natural gas produced	$293,232	$346,471	$493,686	$522,575
Value of coal and wood displaced	$1,655,942	$1,771,077	$1,992,726	$2,262,711
Domestic consumers supplied	[a]95,161	50,536	57,935	67,203
Iron and steel works supplied	0	1	....	1
Glass works supplied	2	8	5	6
Other establishments supplied	96	206	203	444
Total establishments supplied	98	215	208	451
Total wells producing Jan. 1	535	583	652	707
Total productive wells drilled	53	69	75	78
Total wells abandoned	8	14	20	31
Total wells producing Dec. 31	580	638	707	[b]754
Total dry holes drilled	14	8	11	12
Total feet of pipe laid to Dec. 31	5,785,038	5,894,517	7,413,194	7,899,723
Number of establishments reporting	114	116	144	153

[a] Number of domestic fires supplied. [b] Includes 8 wells not used in 1904.

KENTUCKY.

The greater part of the natural gas produced in Kentucky is found in Martin County, in the eastern portion of the State, and in Breckinridge County, in the northwestern portion. The former area supplies Ashland, Buchanan, Louisa, Warfield, and Inez, in Kentucky, Huntington, W. Va., and Ironton, Ohio. The latter area supplies Louisville in part. There are gas wells in Hardin, Jefferson, Meade, Morgan, Wayne, Estill, Pendleton, Clinton, Lawrence, Rockcastle, and Menifee counties. The natural gas produced in Wayne County is partially used in drilling and operating wells. The gas wells in Jefferson County are used for private houses only.

There were in Wayne County a total of 4 gas wells at the close of 1904, three of which were completed in 1904 and one about three years ago, which is said to be as good as when drilled. One of the wells drilled in 1904 is the first gas well in the Steubenville oil district. It is located 3 miles north of Monticello and was completed in November, since which time the product has been utilized in the drilling of other wells. It is probably the best gas well in the State, showing by Pitot gage an output of 4,327,000 cubic feet daily. The gas was found in stray sand at a depth of 818 feet. It is expected that the product of the two other good wells drilled in 1904 will be supplied to Monticello and Somerset in the near future, and later to Danville and Lexington. Since the 1st of January, 1905, two fair gas wells have been drilled in this county.

In Menifee County there were 15 producing gas wells drilled in 1904 whose combined flow was 10,700,000 cubic feet, none of which was utilized. These wells are from 600 to 700 feet deep and find the natural gas in the Corniferous limestone.

In Estill County, a well on White Oak Creek after penetrating the Trenton limestone, passed into the sandy Calciferous and is producing a fair flow of high-pressure gas from that horizon at a depth of 1,940 feet. The gas is not utilized. A well is also reported to have found a flow of natural gas in this same horizon at Elizabethtown in Hardin County at a depth of 2,300 feet, near where a strong flow of Blue Lick water was also encountered.

In Morgan County two very good gas wells have been completed, the product of which is used to supply domestic consumers in Hazelgreen. The gas wells are 1,350 feet deep and have a pressure of 500 pounds. The gas is very pure, clean, and dry, and no exhaustion is yet visible.

In 1904, a gas well, with an estimated capacity of 500,000 cubic feet daily, was completed at Caney in Morgan County. The gas was found at a depth of 1,609 feet, and the rock pressure is estimated at 700 pounds. The product has not been utilized.

The indications are that Kentucky may become one of the large producing States in natural gas in the future, as there were 27 gas wells completed in the State in 1904, which ranged from 500,000 to 4,000,000 cubic feet per day.

The value of the natural gas produced in Kentucky from 1889 to 1904 is shown in the following table:

Value of natural gas produced in Kentucky, 1889–1904.

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	1904	[b] 322,404

[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.

One gas well in Franklin County and the Beatty well in Fentress County are the only ones used in this State of which we have any knowledge. The product of the Franklin County well was used in 1904 to light and heat one dwelling house, also to run a 6-horsepower engine and waterworks plant.

KANSAS.

Some very large natural-gas wells were developed in Kansas in 1904, whose discovery was in part due to the large amount of drilling that was done in search of petroleum, and which, from all appearances, must soon put Kansas among the greatest natural-gas producing States.

A number of these powerful natural-gas wells were developed a few miles south and east of Independence, Montgomery County, which rivaled in magnitude some of the largest wells found in Pennsylvania, Ohio, and West Virginia. Previously wells producing half a million cubic feet were common, and a few producing 10,000,000 cubic feet had been developed. These large gas wells are often found interspersed with those producing petroleum, but usually at greater depths.

Early in 1904 a remarkably large natural-gas well was drilled near Caney, in Montgomery County, which produced 20,000,000 cubic feet per day, and this was followed by other wells in the same locality which produced from 10,000,000 to 15,000,000 cubic feet. In April, 1904, a record-breaking well was drilled on the Johnson farm, 5½ miles southwest of Independence, which gages 37,000,000 cubic feet per day. On the Klumpp farm, 6 miles south of Independence, a 16,000,000 cubic foot well was found, and 1 mile farther south a 28,000,000 cubic foot well was secured. These were followed by other large wells from 4 to 5 miles south of Independence, which ranged from 5,000,000 to 9,000,000 cubic feet in capacity per twenty-four hours. On the M. E. Bennett farm, 7 miles southwest of the Johnson strike, well No. 1 showed 21,000,000 cubic feet, and well No. 2 showed 19,000,000 cubic feet; and on the B. F. Logan farm two wells were completed which together aggregated about 25,000,000 cubic feet per day. Near Dearing, toward the close of 1904, a well producing 33,000,000 cubic feet was struck. These mentioned are only the notably large wells. There were a considerable number found ranging from 500,000 to 3,000,000 cubic feet capacity. A number of other wells that are powerful producers were found within a radius of 20 miles of Independence. North of Indendence the rock pressure was about 550 pounds to the square inch; south of Independence it was about 650 pounds to the square inch.

More or less gas has accompanied almost every petroleum pool that has been thus far developed. The gas has been found in the sandstones and in the more porous beds of the Cherokee shales, which are at the base of the Coal Measures in the Kansas field.

There is no 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 southwestward as the result of the dip, and in the more productive belt the depth varies from 700 to 1,140 feet. There are numerous local dips and flexures which cause the oil and gas wells to be irregularly dispersed. The original rock pressure was in many instances 320 pounds to the square inch, but it has decreased in the older fields to about 120 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 also in the manufacture of brick and hydraulic cement and in numerous other manufactures.

Several projects have been started to organize pipe-line companies to transport the immense quantity of natural gas recently developed in southern Kansas to points outside of the State. These have thus far met with more or less violent opposition on the part of many of the inhabitants, who claim that it would be more profitable to hold the gas near where it originates and bring manufactures and other industries within the State. This feeling of opposition seems to be gradually subsiding, and the indications are that before the close of 1905 Kansas City, Mo., and numerous towns and villages will be enjoying the benefits of natural gas transported from southern Kansas.

The value of the natural gas produced and sold in Kansas during 1904 was $1,517,643, an increase of $393,794 over 1903. The prolific wells already enumerated were not found until near the close of the year. The entire production was marketed inside the State, and, owing to the low figures at which most of it was sold, the value of the coal and wood displaced was $2,275,875. There were 378 productive gas wells drilled during the year, and 75 were abandoned. The total number of productive wells at the close of 1904 was 1,029; of this number 150 of the largest were shut in for want of a market.

There were 270 miles of pipe line laid during the year.

Indications point to a greatly increased value for the production of natural gas in Kansas in the future.

The value of the natural gas produced in Kansas from 1889 to 1904 has been as follows:

Value of natural gas produced in Kansas, 1889–1904.

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	1904	1,517,643

The following table gives in detail the record for natural gas in Kansas during 1901, 1902, 1903, and 1904:

Record of natural-gas industry in Kansas, 1901, 1902, 1903, and 1904.

	1901.	1902.	1903.	1904.
Amount received for sale of gas or value of gas consumed	$659,173	$824,431	$1,123,849	$1,517,643
Value of natural gas produced	$659,173	$824,431	$1,123,849	$1,517,643
Value of coal and wood displaced	$995,350	$1,175,349	$1,676,351	$2,275,875
Domestic consumers supplied	10,227	13,488	15,918	27,204
Iron and steel works supplied	0	1	2	10
Zinc smelters supplied	8	9	11	16
Glass works supplied	0	3	3	14
Brick works supplied	12	14	14	17
Other establishments supplied	52	64	113	241
Total establishments supplied	72	91	143	298
Total wells producing Jan. 1	213	299	404	726
Total productive wells drilled	71	144	295	378
Total wells abandoned	28	24	33	75
Total wells producing Dec. 31	256	419	[a] 666	[b] 1,029
Total dry holes drilled	35	63	66	135
Total feet pipe laid to Dec. 31	2,425,410	5,034,791	5,598,720	7,022,852
Number of establishments reporting	48	80	120	190

[a] Includes 124 wells which were not in use in 1903.
[b] Includes 150 wells which were not in use in 1904.

INDIAN TERRITORY AND OKLAHOMA.

There were about 45 gas wells in these Territories at the close of 1904, only 24 of which were utilized in that year. The development of this field has been rapid, and some very good wells have been found. On the 1st of January, 1903, there were only two gas wells on the Osage Reservation, but at the close of 1904 there were about 30 gas wells. Much of the gas in these Territories is used for drilling and operating oil wells, but during 1904 consumers in Tulsa, Bartlesville, Ochelata, Pawhuska, and Red Fork were being supplied with gas for fuel purposes, while Ramona was being piped and will be supplied in 1905. Some gas is used for manufacturing purposes, a brick works at Red Fork being supplied in 1904. It is reported that another brick works and a glass factory will be using gas in 1905.

ARKANSAS.

Gas produced from 7 wells located in Sebastian County, Ark., was supplied to consumers in Mansfield and Huntington in 1904. On January 1, 1905, consumers in Fort Smith began using gas. Five of these wells were drilled in 1904, the depths of which are as follows: No. 7, gas found at 1,136 feet, depth 1,530 feet; No. 8, gas found at 1,190 feet, depth 1,700; No. 9, gas found at 1,320 feet, depth 1,740; No. 10, gas found at 1,385 feet, depth 1,385; No. 11, gas found at 1,220 feet, depth 1,970.

In Nos. 8 and 10 gas was found in shale; in Nos. 7, 9, and 11, in sand.

The gas is excellent for domestic use, burning without odor. It is free from water and sulphur, very pure, and a good heater; no oil was found.

ILLINOIS.

Gas is found in Bureau, Randolph, Crawford, and Clark counties. The wells of Bureau County are small, each producing barely enough gas for one house. The gas is found at a shallow depth. At Sparta, Randolph County, the wells have almost ceased flowing. Two wells were drilled near Palestine in Crawford County in 1904, the product of which is supplied to domestic consumers in Palestine. The sand was reached at a depth of 650 feet. In Clark County one gas well was drilled in at a depth of 330 feet, the product of which has not yet been utilized.

The production of natural gas in Illinois from 1889 to 1904 was valued as follows:

Value of natural gas produced in Illinois, 1889–1904.

Year.	Value.	Year.	Value.
1889	$10,615	1897	$5,000
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	1904	4,745

MISSOURI.

Gas is produced from wells in Bates, Cass, Jackson, and Clay counties, though all of these wells are very small producers. The gas from wells in Bates County is used principally by the farmers, who drill the wells and supply their own dwellings. A few domestic consumers in the town of Hume, Bates County, are being supplied with gas from 3 wells in Hume. At West Line, Cass County, is a well the product of which is used to supply a few domestic consumers in the town of West Line. Near Belton, Cass County, are located 3 wells the product of which is supplied to domestic consumers in Belton; the gas is found at a depth of from 275 to 375 feet. Gas from a well in Jackson County is used to operate a 100-horsepower gas engine. One gas well is located at Holt, Clay County, but as yet no gas has been marketed. Other wells will probably be drilled in this locality in the near future.

ALABAMA.

The New York-Alabama Oil Company is the only company operating in the neighborhood of Huntsville. The company has two gas wells, one with a pressure of 118 pounds per square inch; the other well has not been tested. The wells are located near Hazelgreen, 16 miles north of Huntsville. Gas from one well was utilized in 1904, the first time that natural gas has been used in the State of Alabama; it is of very fine quality. This company also drilled two other wells which showed small quantities of petroleum, but these wells have been temporarily abandoned. The fifth well is now drilling. It is expected that gas will be piped to the principal towns in the locality. During 1904 the gas was used for fuel in drilling wells.

LOUISIANA.

Two wells have been drilled at Raceland, Lafourche Parish, which are reported as producing some gas. The property is still under development, and no practical results of importance have yet been obtained. No use has yet been made of the gas. There are numerous natural-gas escapes in many parts of this State; one in Caddo Parish near Dooley has furnished sufficient natural gas for several dwellings for a number of years.

TEXAS.

The value of the natural gas produced in Texas and Alabama during 1904 was $14,082, nearly all of which was produced in Texas; the production in Texas was $13,851 in 1903, $14,953 in 1902, and $18,577 in 1901. Nearly all the gas consumed in this State is taken from wells near Corsicana. Some natural gas was consumed in past years 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 from 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.

COLORADO.

Most of the gas consumed in Colorado is supplied to consumers in Boulder. The rock pressure is 380 pounds, and is higher than it was one year ago. One well only is used to supply the town. Three other wells at Boulder have not been used.

Some gas from oil wells at Florence is consumed for domestic and other purposes.

WYOMING.

The oil and gas fields of Wyoming are in process of development. In the Brenning Basin district, near Douglas, have been drilled 4 wells which are gas producers. The gas utilized in 1904 was used in the field both for fuel and illuminating purposes. Arrangements are being made to pipe the gas to Douglas, where it will be supplied to consumers for heating and lighting. One well is reported to have a pressure of 149 pounds.

UTAH.

Formerly natural gas was produced near the shore of Great Salt Lake and piped to Salt Lake City. Owing to the wells filling up from the decomposed slate below the casing, they ceased to be productive and have not produced since 1898. During 1904 a number of deep wells were drilled in several localities along the shore of the receding waters of Great Salt Lake, none of which have developed any permanent flow, a few pockets of high-pressure gas, which were soon exhausted, being found in one or two instances.

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 1904 has been as follows:

Value of natural gas produced in South Dakota, 1899–1904.

Year.	Value.	Year.	Value.
1889	$3,500	1902	$10,280
1900	9,817	1903	10,775
1901	7,255	1904	12,215

CALIFORNIA.

Natural gas is produced from wells in San Joaquin, Sacramento, Santa Barbara, Ventura, Orange, Los Angeles, and Tehama counties. Most of the domestic consumers using gas in California are supplied from wells in San Joaquin and Sacramento counties, the towns of Stockton and Sacramento being supplied. During 1904, however, nine gas wells were drilled in Ventura county, the product of which is supplied to domestic consumers in Ventura and Oxnard. At Fairview, Orange County, is located a well, the product of which is used in a hotel and in cottages. At Tuscan Springs, Tehama County, are two wells, the product of which is used at the hotel and grounds for fuel and lighting. The wells in Santa Barbara are small gas producers. Gas from Los Angeles County wells is produced with the oil and partially utilized. In the report for 1904 no figures are included for the value of gas produced from oil wells.

The value of the natural gas produced in California from 1889 to 1904 is shown in the following table:

Value of natural gas produced in California, 1889–1904.

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	79,083
1893	62,000	1901	67,602
1894	60,350	1902	[a] 120,648
1895	55,000	1903	[b] 104,521
1896	55,682	1904	114,195

[a] Includes $32,138 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.

CANADA.

There was an increase in the value of natural gas produced in Canada during 1904, 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, N. Y.

Statistics of natural-gas production in the Province of Ontario, Canada, 1893–1904.

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
1904	176	231	9	253,524	53,674

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 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. During 1904 there were in operation six wells owned by the town, and a well drilled by the Canadian Pacific Railroad found a fair flow of natural gas at 986 feet, with 525 pounds rock pressure.

Indications from surface examinations show a large area of prospective natural-gas territory in this section.

NATURAL GAS IN ENGLAND.

Drilling operations have again been commenced at Heathfield, where the natural gas is obtained, and the workings have now been brought under the coal mines regulation act.

Natural inflammable gas was discovered at Heathfield, in Sussex, some years ago when a well was being bored with the object of obtaining water. The gas is now used for lighting purposes and for the production of power. During the year 1903 the quantity of natural gas supplied at Heathfield was 972,460 cubic feet, valued at £194; in 1902 the production was 150,000 cubic feet, valued at £30. Its composition is very similar to that produced in the United States.

ASPHALTUM AND BITUMINOUS ROCK.

By Edmund Otis Hovey.

INTRODUCTION.

Asphaltum is a term rather loosely used in commerce for any or all of the varieties of hydrocarbon compounds which the mineralogist knows as asphaltum proper, elaterite, wurtzilite, albertite, grahamite, uintaite, and gilsonite, together with some other less well-known forms which occur in all conditions in nature from viscid to solid. The terms used in the tables of this report are only those which obtain in the trade. Within the last few years a large industry has grown up in California from the fact that the petroleum of the State yields, on destructive distillation, a residue which so closely resembles asphalt that it is called "oil asphaltum." It is extensively used as a roofing and paving material.

PRODUCTION.

The following table shows the annual production of asphaltum and bituminous rock in the United States from 1882 to 1904, inclusive:

Production of asphaltum and bituminous rock, 1882–1904.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1882	3,000	$10,500	1894	60,570	$353,400
1883	3,000	10,500	1895	68,163	348,281
1884	3,000	10,500	1896	80,503	577,563
1885	3,000	10,500	1897	75,945	664,632
1886	3,500	14,000	1898	76,337	675,649
1887	4,000	16,000	1899	75,085	553,904
1888	50,450	187,500	1900	54,389	415,958
1889	51,735	171,537	1901	63,134	555,335
1890	40,841	190,416	1902	105,458	765,048
1891	45,054	242,264	1903	101,255	1,005,446
1892	87,680	445,375	1904	81,572	903,741
1893	47,779	372,232			

In the preceding table the term "asphaltum" includes oil asphaltum as well as all the natural asphalts, and the term "bituminous rock" covers the asphaltum-bearing sandstones and limestones which are quarried in some States and used alone or mixed with other broken rock in the making of street pavements.[a]

From the following table, which classifies the production according to varieties, it will be seen that the output of bituminous sandstone decreased from 38,633 short tons ($118,001) in 1903 to 19,641 short tons ($71,465) in 1904. Mastic, which has been reported separately for several years, is given at 961 short tons ($11,532) in 1903, most of which was produced from bituminous sandstone quarried in Kentucky, and increased to 1,200 short tons, valued at $10,800, in 1904. The production of hard and refined or gum asphalt shows an increase in quantity from 12,896 short tons ($343,799) in 1903 to 15,012 short tons ($224,446) in 1904, though there was a decrease in value in 1904 of $119,353. The production of liquid asphaltum or maltha was 3,360 short tons, valued at $36,260, reported from California, and 3 short tons, valued at $60, reported from Texas. The production of oil asphaltum decreased from 46,187 short tons ($522,164) in 1903 to 36,030 short tons ($376,135) in 1904, and the average value per ton decreased from $11.31 to $10.44. This decline of nearly 22 per cent in output for 1904 as compared with 1903 is accounted for by the low price obtained for the product, and by the severe competition of the companies producing natural asphalt, which has closed several of the refineries that were in operation in 1903. The distribution of the oil asphaltum of California is now cared for by the California Asphaltum Sales Agency, for the purpose of insuring greater uniformity in the quantity and quality of the oil-asphaltum produced and in the prices realized. Prior to 1902 the asphaltum produced from distilling petroleum was included under the heading of "Hard and refined, or gum."

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[a] For detailed descriptions of the deposits of the country, see 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. See also Prutzman, P. W., Production and use of petroleum in California: California State Mining Bureau, Bull. 32, 1904, San Francisco.

PRODUCTION BY VARIETIES AND BY STATES.

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 is first sold:

Varieties of asphaltum, etc., produced annually, 1897–1903.

[Short tons.]

Variety.	1897.		1898.		1899.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bituminous sandstone	48,801	$158,914	43,624	$126,831	43,041	$121,023	38,334	$119,779
Bituminous limestone [a]	2,100	10,600	5,502	26,412	15,650	79,500	2,434	11,322
Mastic	483	9,864	1,158	17,840				
Hard and refined, or gum [b]	9,911	173,904	13,178	233,566	15,694	343,730	12,367	256,793
Liquid, or maltha	14,650	311,350	12,875	271,000	700	9,651	1,254	28,064
Total	75,945	664,632	76,337	675,649	75,085	553,904	54,389	415,958

Variety.	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bituminous sandstone	34,248	$138,601	57,837	$156,993	38,633	$118,001	19,641	$71,465
Bituminous limestone [a]	6,970	33,375	2,869	19,817	2,520	8,800	1,798	4,495
Mastic					961	11,532	1,200	10,800
Hard and refined, or gum	19,316	333,509	22,321	264,817	12,896	343,799	15,012	224,446
Liquid, or maltha	2,600	49,850	1,605	20,172	58	1,150	3,363	36,320
Elaterite [c]							550	50,000
Gilsonite [c]							2,978	105,080
Grahamite [c]							1,000	25,000
Oil asphaltum			20,826	303,249	46,187	522,164	36,030	376,135
Total	63,134	555,335	105,458	765,048	101,255	1,005,446	81,572	903,741

Distribution of production of asphaltum in 1904, by States.

[Short tons.]

Variety.	California.		Texas.		Pennsylvania.		Kentucky.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bituminous sandstone	6,814	$19,264					5,670	$31,185
Bituminous limestone [a]								
Mastic					1,200	$10,800		
Hard and refined, or gum	14,075	207,770						
Liquid, or maltha	3,360	36,260	3	$60				
Elaterite [c]								
Gilsonite [c]								
Grahamite [c]								
Oil asphaltum	36,030	376,135						
Total	60,279	639,429	3	60	1,200	10,800	5,670	31,185

Variety.	Indian Territory.		Arkansas.		Missouri.		Utah.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Bituminous sandstone	5,457	$12,516	1,700	$8,500				
Bituminous limestone [a]					1,798	$4,495		
Mastic								
Hard and refined, or gum					937	16,676		
Liquid, or maltha								
Elaterite [c]							550	$50,000
Gilsonite [c]							2,978	105,080
Grahamite [c]	1,000	25,000						
Oil asphaltum								
Total	6,457	37,516	1,700	8,500	2,735	21,171	3,528	155,080

[a] Not including mastic or refined asphaltum made from bituminous limestone.
[b] Including gilsonite from Colorado and Utah, gum asphaltum from Texas, and "Ventura" hard asphaltum, from California.
[c] Prior to 1904 included under "Hard and refined, or gum."

The following table of chemical analyses gives the means of comparing the California oil-asphalt with the natural asphalts of Venezuela and Trinidad:

Analyses of California oil-asphalt and Venezuela and Trinidad natural asphalts.

	Bitumen.	Mineral matter.	Vegetable matter.	Authority.
	Per cent.	*Per cent.*	*Per cent.*	
California oil-asphalt	98.26	1.74	....	Tillson.
Bermudez natural asphalt	98.52	.50	0.98	Richardson.
Bermudez natural asphalt	94.75	3.65	1.60	Richardson.
Bermudez natural asphalt	91.88	1.67	6.45	Richardson.
Trinidad natural asphalt	54.25	36.51	9.24	Richardson.
Trinidad natural asphalt	54.03	36.49	9.48	Richardson.
Trinidad natural asphalt	52.97	36.10	10.96	Linton.
Trinidad natural asphalt	52.57	35.88	11.52	Linton.
Trinidad natural asphalt	5[illegible].27	37.73	10.01	Richardson.

EXPORTS.

During the fiscal year ending June 30, 1904, asphaltum and manufactures of asphaltic material of domestic production to the total value of $160,186 were exported from the United States to other countries. The most important receivers of these products were, in the order named, Dominion of Canada, Germany, United Kingdom, Peru, and France. The corresponding exports for the fiscal year ending June 30, 1903, amounted to $104,586.

IMPORTS.

Nearly 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), Cuba, and France. Smaller quantities, mostly in the shape of bituminous limestones, are imported from Nova Scotia, Turkey in Asia, British India, Mexico, Colombia, United Kingdom, and Italy.

The following table shows the imports of crude asphaltum by fiscal years from 1867 to 1885, and by calendar years from 1886 to 1904, inclusive:

Crude asphaltum imported for immediate consumption into the United States, 1867–1904.

[Long tons.]

Year ending—	Quantity.	Value.	Year ending—	Quantity.	Value.
June 30—			December 31—		
1867	....	$6,268	1886	32,565	$108,528
1868	185	5,632	1887	30,808	95,735
1869	203	10,559	1888	36,494	84,045
1870	488	13,072	1889	61,952	138,163
1871	1,301	14,760	1890	73,861	223,368
1872	1,474	35,533	1891	102,433	299,350
1873	2,314	38,298	1892	120,255	336,868
1874	1,183	17,710	1893	74,774	196,314
1875	1,171	26,006	1894	102,505	313,680
1876	807	23,818	1895 [a]	79,557	210,556
1877	4,532	36,550	1896 [a]	96,192	304,596
1878	5,476	35,932	1897 [a]	115,528	392,770
1879	8,084	39,635	1898 [b]	69,857	213,385
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	1904	119,599	590,890

[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 3,834 long tons, "dried or advanced," valued at $32,513.
[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 decreased from 129,133 long tons ($367,003) in the fiscal year ending June 30, 1903, to 110,031 long tons ($368,623) in the fiscal year ending June 30, 1904, while the imports from Venezuela increased from 16,445 long tons in 1903 ($74,874) to 50,194 long tons ($217,017) in 1904. In 1904 the imports from the British West Indies include 649.5 short tons of manjak, valued at $28,578. The imports from Cuba show a decrease from 9,898 long tons ($48,218) in 1903 to 9,494 long tons ($22,230) in 1904. The imports from Italy fell off from 13,789 long tons ($61,284) in 1903 to 3,211 long tons ($11,581) in 1904. The imports from Cuba remain about the same as in 1903, but there is an unexplained drop of more than 50 per cent in valuation.

The increase in quantity and value of asphalt received from Venezuela more than made good the decrease in imports from other countries, so that the total importations in 1904 were 175,640 long tons, valued at $643,785, as compared with imports of 172,892 long tons, valued at $585,865, in 1903.

Imports of asphaltum during the fiscal years ending June 30, 1900, 1901, 1902, 1903, and 1904, with the countries from which exported.

[Long tons.]

Country.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
West Indies:						
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
Total	106,162	363,291	136,440	497,194	119,625	428,877

Country.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
West Indies:				
British (Trinidad)	129,133	$367,003	110,031	$368,623
Cuba	9,898	48,218	9,494	22,230
Venezuela (Bermudez)	16,445	74,874	50,194	217,017
Italy	13,789	61,284	3,211	11,581
Germany	1,422	9,974	1,528	11,755
Switzerland	442	3,735	414	3,815
Mexico	621	2,369	382	2,223
Nova Scotia			130	1,032
Turkey in Asia	67	5,038	119	2,763
United Kingdom	136	2,885	63	932
British India			49	312
United States of Colombia	3	106	23	1,456
Austria-Hungary			2	46
Turkey in Europe	638	8,917		
France	298	1,462		
Total	172,892	585,865	175,640	643,785

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).

The exports of asphalt from Trinidad fell off greatly during the year ending January 31, 1905, the amount (134,930 long tons) being the smallest reported for the last six years. Nearly five-sixths of the material is obtained from Pitch Lake,[a] a deposit which is being exploited by the New Trinidad Lake Asphalt Company (Limited) under a long-term lease. The "lake" constantly receives fresh supplies of asphalt from subterranean sources, but the amount thus coming in annually is much less than that which is being removed from the top. More than 2,160,000 long tons of asphalt have been removed from Pitch Lake and exported to foreign countries since the records have been kept.

Exports of Pitch Lake asphaltum from Trinidad, 1881–1904.

[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	15,703	13,228	35,537	[b] 693	[c] 1,646	2,999	86,959
1899 [d]	70,111	666	70,777	21,337	20,618	41,955		2,359	2,359	115,091
1900 [d]	67,758	3,180	70,938	23,386	23,966	47,352	1,422	3,031	4,453	122,743
1901	80,449		80,449	31,213	15,815	54,761		586	844	136,054
1902	101,876	2,211	104,956	17,711	10,509	33,474		536	746	139,176
1903 [e]	118,661	3,536	123,582	27,025	13,921	40,946	1,000	3	1,004	165,532
1904 [f]	59,325	2,670	63,033	28,970	12,249	47,296		980	1,359	111,688

[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.
[e] Report for thirteen months ending January 31, 1904.
[f] Year ending January 31, 1905.

Exports of land asphaltum from Trinidad, 1886–1904.

[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	1,988	3,824	....	....	....	15,873
1897	19,243	....	19,243	293	700	1,343	415	178	682	21,268
1898	15,160	....	18,160	700	258	1,087	404	312	872	20,119
1899 [c]	24,622	542	25,164	275	250	525	80	298	378	26,067
1900 [c]	33,936	860	34,796	251	....	251	127	70	197	35,244
1901	31,767	([d])	31,767	1,704	([d])	1,704	1,446	....	1,446	34,917
1902	25,003	100	25,153	200	....	200	15	50	90	25,443
1903 [e]	18,478	....	18,478	2,258	628	3,200	1,347	224	1,686	23,361
1904 [f]	22,432	100	22,582	....	100	150	360	100	510	23,242

[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.
[e] Report for thirteen months ending Jan. 31, 1904.
[f] Year ending Jan. 31, 1905.

Total exports of all asphaltum from Trinidad, 1886–1904.

[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	98,819
1897	74,407	19,243	93,650	34,856	1,343	36,199	680	682	1,362	131,211
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 [b]	123,582	18,478	142,060	40,946	3,200	44,146	1,004	1,686	2,690	188,896
1904 [c]	63,033	22,582	85,615	47,296	150	47,446	1,359	510	1,869	134,930

[a] The dried and "épuré" in 1899 and 1900 are not reduced to crude equivalents.
[b] Report for thirteen months ending Jan. 31, 1904.
[c] Year ending Jan. 31, 1905.

BARBADOS.

Manjak or glancepitch is a very pure form of land asphaltum which occurs in limited quantity in the island of Barbados and elsewhere. It is used in the manufacture of Brunswick varnish, which is utilized for the insulation of electric cables, for waterproofing, and for other similar purposes. The annual production of manjak in Barbados has decreased greatly within the last ten years, as is shown by the following report of exportation to all countries: 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; 1904, about 649.5 long tons (to the United States alone).

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, have more than regained their previous importance, the legal troubles between the companies having been settled. The imports into the United States from Venezuela during the year ending June 30, 1904, were more than twice as great as during any previous year.

CUBA.

As may be seen from the tables already given, the asphalt industry in Cuba has expanded greatly in recent years. About three-fifths of the asphalt exported from Cuba during the fiscal year ending June 30, 1904, was sent to the United States.

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 1903, inclusive:

Production of asphaltum in principal producing countries, 1890–1903.

[Short tons.]

Year.	United States.		Trinidad.		Germany.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1890	40,841	$190,416	94,834	$254,019	59,361	$89,961
1891	45,054	242,264	110,929	297,132	54,163	89,419
1892	87,680	445,375	129,438	347,310	58,713	99,686
1893	47,779	372,232	106,515	285,309	52,056	84,962
1894	60,570	353,400	121,186	324,606	61,691	107,350
1895	68,163	348,281	102,368	274,200	65,638	108,153
1896	80,503	577,563	110,667	296,457	67,830	107,908
1897	75,945	664,632	146,172	292,344	67,933	91,984
1898	76,337	675,649	112,220	553,890	75,550	99,088
1899	75,085	553,904	153,870	745,242	82,397	123,984
1900	54,389	415,958	177,751	855,744	98,833	160,000
1901	63,134	555,335	191,488	799,010	99,420	168,750
1902	[a] 84,632	461,799	178,230	828,347	97,415	146,470
1903	[a] 55,068	483,282	[b] 211,564	....	96,401	198,940

[a] Oil asphaltum is excluded from this table of crude production, since it is a product of distillation.
[b] Exports.

Production of asphaltum in principal producing countries, 1890–1903—Continued.

Year.	France.		Italy.		Spain.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1890	198,934	$335,092	49,728	$232,351	47	$94
1891	278,316	402,631	31,054	131,028	274	505
1892	246,848	323,854	38,107	162,308	554	1,014
1893	244,644	311,116	28,630	109,200	904	1,235
1894	254,562	339,294	66,663	270,854	1,085	1,939
1895	294,234	355,700	51,478	197,584	870	1,525
1896	249,052	336,013	50,092	171,507	1,231	2,156
1897	257,127	328,002	60,984	183,017	1,825	3,196
1898	252,358	322,117	103,312	256,347	2,604	4,605
1899	285,208	356,719	90,350	222,519	2,801	4,964
1900	293,654	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
1903	267,859	353,535	98,865	240,497	6,918	12,240

Year.	Austria-Hungary.		Russia.		Venezuela.
	Quantity.	Value.	Quantity.	Value.	Quantity.
1890	....	....	....	....	....
1891	43	$258	15,471	$108,000	....
1892	48	288	20,838	118,760	....
1893	97	624	18,337	120,000	1,771
1894	2,740	75,696	17,706	176,400	7,751
1895	2,963	59,001	20,699	144,893	3,073
1896	3,449	72,429	20,043	133,141	6,197
1897	3,699	81,104	24,488	171,416	11,528
1898	4,152	86,018	13,244	128,176	....
1899	6,276	79,634	25,435	170,300	12,014
1900	3,787	70,603	27,657	....	17,981
1901	3,770	69,164	29,345	250,650	24,378
1902	4,047	67,623	13,624	116,935	11,872
1903	2,715	62,492	(a)	....	[b]16,057

[a] Statistics not yet available. [b] Exports.

STONE.[a]

INTRODUCTION.

A comparison of the total stone output of the United States for the last four or five years furnishes a fairly good summary of the standing of the stone trade for the present year, and also indicates to some extent the activity or depression of building construction, road-improvement work, and the general condition of the many trades connected with the quarrying of stone.

The years 1901 and 1902 showed a large increase in the stone output of the country, which was forwarded by an increase in the building industry, the use of crushed stone for concrete ballast and road improvement, the export trade in slate, the construction of bridges requiring heavy stone for foundations, the use of a large quantity of limestone for iron-furnace flux, and of an immense quantity of stone used in the manufacture of Portland cement, but not included in these figures. The paving-block industry was not so prominent in these years, as brick, asphalt, and macadam took the place of blocks. The lime industry was also somewhat affected by the use of cement wall plaster.

To some extent in 1902, and especially in 1903, labor troubles and builders' strikes and less railroad construction caused a general inactivity in quarrying. These causes have had their effect also on the trade in 1904, and therefore the figures show a much less increase than in previous years.

Dr. George P. Merrill, head curator of geology, United States National Museum, has recently cooperated with the United States Geological Survey in the examination of regions of special interest and will from time to time contribute articles to the report on Stone. Dr. Merrill has visited the stone deposits of Florida and of Fairfield County, S. C., and his reports on these regions are embodied in this report.

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[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 prepared the entire report on stone.—D. T. DAY.

PRODUCTION.

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.

In making the statements as to the value of the stone, the figures given represent as nearly as it was possible to obtain it 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 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; and limestone used in the manufacture of Portland cement.

In this report for the first time are included figures showing the quantity of lime burned.

The total value of the stone reported to this office in 1904 was $74,200,361. The value in 1903 was $72,945,908—a gain of $1,254,453 for 1904. The corresponding gain in 1903 over 1902, when the figures were $69,830,351, was $3,115,557. In 1902 the gain over 1901, when the total value was $60,275,762, was $9,554,589; and in 1901 the gain was $12,267,023 over 1900.

In 1904 granite, marble, and limestone increased in value, while slate and sandstone decreased.

Granite showed the largest increase. In 1904, including trap rock, the total value was $19,992,983; in 1903 it was $18,436,087, a gain of $1,556,896 for 1904. The granite production increased from $15,703,793 in 1903 to $17,169,437 in 1904, a gain of $1,465,644; and the trap rock from $2,732,294 in 1903 to $2,823,546 in 1904, a gain of $91,252.

Sandstone, including bluestone, decreased in value from $11,262,259 in 1903 to $10,295,933 in 1904, a loss of $966,326. The value of bluestone included in the sandstone was $1,779,457 in 1903, and $1,791,729 in 1904, an increase of $12,272. The sandstone figures decreased from $9,482,802 in 1903 to $8,504,204 in 1904, a loss of $978,598.

The value of marble increased from $5,362,686 in 1903 to $6,297,835 in 1904, a gain of $935,149.

The slate output was valued at $6,256,885 in 1903, and at $5,617,195 in 1904, a loss of $639,690.

The limestone output remained nearly the same, being valued at $31,627,991 in 1903, and $31,996,415 in 1904, a gain of $368,424 in 1904.

The following table shows the value of different kinds of stone produced in the United States from 1895 to 1904, inclusive:

Value of the different kinds of stone produced in the United States, 1895–1904.

Year.	Granite.	Trap rock.	Marble.	Slate.	Sandstone.	Bluestone.	Limestone.	Total.
1895....	$8,894,328	....	$2,825,719	$2,698,700	$4,211,314	a $750,000	$16,563,044	$35,943,105
1896....	7,944,994	....	2,859,136	2,746,205	4,023,199	a 750,000	13,879,127	32,202,661
1897....	8,905,075	....	3,870,584	3,524,614	4,065,445	a 900,000	15,526,054	36,791,772
1898....	9,324,406	....	3,629,940	3,723,540	4,724,412	a 1,000,000	16,842,966	39,245,264
1899....	10,343,298	$1,275,041	4,011,681	3,962,733	b 4,924,670	815,284	23,453,168	48,785,875
1900....	10,969,417	1,706,200	4,267,253	4,240,466	b 5,272,865	1,198,519	20,354,019	48,008,739
1901....	14,266,104	1,710,857	4,965,699	4,787,525	b 6,974,199	1,164,481	26,406,897	60,275,762
1902....	16,076,787	2,181,157	5,044,182	5,696,051	b 9,437,646	1,163,525	30,231,003	69,830,351
1903....	15,703,793	2,732,294	5,362,686	6,256,885	b 9,482,802	1,779,457	31,627,991	72,945,908
1904....	17,169,437	2,823,546	6,297,835	5,617,195	b 8,504,204	1,791,729	31,996,415	74,200,361

a Estimated. b Does not include value of grindstones and whetstones.

The following tables show the value of stone produced in the United States in 1903 and 1904, by States:

Value of various kinds of stone produced in 1903 and 1904, by States.

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	3,375,378
Colorado	100,791	389,132			218,120	708,043
Connecticut	b 1,101,425	119,417		(a)	154,536	1,375,378
Delaware	369,166					369,166
Florida					64,893	64,893
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			736,590	830,332
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	190,608	268,890
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	31,627,991	72,945,908

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.

Value of various kinds of stone produced in 1903 and 1904, by States—Continued.

1904.

State.	Granite.	Sandstone.	Slate.	Marble.	Limestone.	Total value.
Alabama		$12,788		(a)	$735,528	$748,316
Alaska				(a)		
Arizona	$2,500	91,960		(a)	12,450	106,910
Arkansas	52,616	63,950	$14,300	(a)	248,860	379,726
California	[b]1,742,330	735,662	39,200	$87,659	660,156	3,265,007
Colorado	91,132	281,142			158,960	531,234
Connecticut	[b]854,784	117,696		(a)	168,937	1,141,417
Delaware	245,272					245,272
Florida					89,363	89,363
Georgia	942,466		4,500	690,714	73,972	1,711,652
Hawaii		22,042				22,042
Idaho		9,320			46,042	55,362
Illinois		47,377			3,151,890	3,199,267
Indiana		22,681			3,140,679	3,163,360
Indian Territory	5,152				6,270	11,422
Iowa		9,300			533,593	542,893
Kansas		130,516			810,056	940,572
Kentucky		93,622			718,297	811,919
Louisiana		8,315				8,315
Maine	2,400,509		181,168		802,472	3,384,149
Maryland	815,471	8,998	133,972	73,814	437,500	1,469,755
Massachusetts	[b]2,868,305	320,861		183,388	329,707	3,702,261
Michigan		74,868			760,613	835,481
Minnesota	405,956	319,209			591,703	1,316,868
Mississippi	440					440
Missouri	155,716	44,455		(a)	2,875,227	3,075,398
Montana	33,890	64,232			133,915	232,037
Nebraska		142			236,780	236,922
Nevada	1,200	10,558			2,700	14,458
New Hampshire	927,487					927,487
New Jersey	[b]833,518	236,426			226,908	1,296,852
New Mexico		133,390		4,250	3,383	141,023
New York	622,986	[c]1,755,524	71,543	565,987	2,032,536	5,048,576
North Carolina	297,749	250		2,741	16,888	317,628
Ohio		1,808,062			3,396,048	5,204,110
Oklahoma	26,930	2,995			95,246	125,171
Oregon	235,213	6,186			15,581	256,980
Pennsylvania	[b]900,530	[c]2,641,510	3,633,246	90,390	5,246,423	12,512,099
Rhode Island	684,952				32,183	717,135
South Carolina	382,428				33,084	415,512
South Dakota	900	338,970			27,914	367,784
Tennessee		24,868	607	505,259	505,117	1,035,851
Texas	348,317	209,313			387,061	944,691
Utah	7,980	70,168	300	3,950	255,947	338,345
Vermont	2,447,979		1,408,151	4,004,669	194,334	8,055,133
Virginia	510,788	13,522	130,208		442,978	1,097,496
Washington	422,508	88,185		23,098	288,311	822,102
West Virginia		287,381			644,363	931,744
Wisconsin	724,422	158,503			1,409,075	2,292,000
Wyoming	557	30,986		2,000	17,365	50,908
Other States				[d]59,916		59,916
Total	[b]19,992,983	[c]10,295,933	5,617,195	[d]6,297,835	31,996,415	74,200,361

[a] Included in other States.
[b] Includes trap rock.
[c] Includes bluestone.
[d] Includes Alabama, Alaska, Arizona, Arkansas, Connecticut, and Missouri.

The following table is given to show the total values of the stone used for various purposes in 1903 and 1904. 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 1903 and 1904.

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

1904.

Kind.	Building (rough and dressed).	Monumental (rough and dressed).	Flagstone.	Curbstone.	Paving.	Crushed stone.
Granite	$6,940,425	$3,663,682	$58,152	$769,462	$1,983,328	$4,930,003
Sandstone	5,125,858		1,110,163	1,253,492	664,062	1,041,493
Limestone	4,543,760		108,029	277,772	186,670	9,558,626
Marble	2,273,412	2,328,032				
Total	18,883,455	5,991,714	1,276,344	2,300,726	2,834,060	15,530,122

As will be seen from this table the value of stone used for building decreased from $19,795,491 in 1903 to $18,883,455 in 1904, a decrease of $912,036. In 1903 there was a decrease in the building-stone output of $994,850 from 1902, and in 1902 an increase of $3,953,960 over the figures for 1901.

In 1904 there was an increase in monumental stone from $5,767,360 in 1903 to $5,991,714, a gain of $224,354. In 1903 there was a loss of $174,225 as compared with 1902.

Flagstone decreased from $1,422,259 in 1903 to $1,276,344 in 1904, a loss of $145,915.

Curbstone increased from $2,059,713 in 1903 to $2,300,726 in 1904, a gain of $241,013.

Paving decreased from $3,166,079 in 1903 to $2,834,060 in 1904, a loss of $332,019. In 1903 there was a gain of $1,114,686 as compared with 1902.

Crushed stone increased from a total value of $13,188,938 in 1903 to $15,530,122 in 1904, a gain of $2,341,184, as shown in the following table:

Value of crushed stone in the United States in 1903 and 1904.

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

1904.

Kind.	Railroad ballast.	Road making.	Concrete.	Total value.
Limestone	$3,153,002	$3,714,987	$2,690,637	$9,558,626
Sandstone	450,442	341,420	249,631	1,041,493
Granite	904,612	2,506,566	1,518,825	4,930,003
Total	4,508,056	6,562,973	4,459,093	15,530,122

The following tables show the total value of the crushed stone produced in the United States in 1903 and 1904, by States:

Value of crushed stone produced in the United States in 1903 and 1904, by States.

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
Louisiana				
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
Nevada				
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

Value of crushed stone produced in the United States in 1903 and 1904, by States—Continued.

1904.

State	Granite.	Limestone.	Sandstone.	Total value.
Alabama		$17,356		$17,356
Arizona			$1,580	1,580
Arkansas	$34,566	39,050	11,428	85,044
California	610,053	14,075	112,596	736,724
Colorado	20,228		4,655	24,883
Connecticut	299,297			299,297
Delaware	142,752			142,752
Florida		300		300
Georgia	117,280	15,200		132,480
Hawaii			22,042	22,042
Illinois		1,567,192	14,585	1,581,777
Indiana		383,183		383,183
Indian Territory	18	6,076		6,094
Iowa		135,421	100	135,521
Kansas		521,122	49,830	570,952
Kentucky		498,244	2,950	501,194
Louisiana			1,310	1,310
Maine	10,711			10,711
Maryland	271,311	111,147		382,458
Massachusetts	407,843		213,739	621,582
Michigan		176,500	1,800	178,300
Minnesota	51,589	147,496	11,365	210,450
Missouri	69,811	1,369,355	220	1,439,386
Montana	500		1,669	2,169
Nebraska		112,211	32	112,243
Nevada			400	400
New Hampshire	15,521			15,521
New Jersey	759,773	2,984	7,113	769,870
New Mexico			130,894	130,894
New York	480,236	948,363	29,915	1,458,514
North Carolina	93,396	12,088		105,484
Ohio		1,345,414	26,390	1,371,804
Oklahoma		60,020		60,020
Oregon	98,814		111	98,925
Pennsylvania	667,093	1,281,992	240,541	2,189,626
Rhode Island	130,573			130,573
South Carolina	72,893	125		73,018
South Dakota		2,400	31,826	34,226
Tennessee		147,004	2,733	149,737
Texas	70,407	42,649	45,356	158,412
Utah		13,195		13,195
Vermont	2,360	4,231		6,591
Virginia	239,335	38,249	12,672	290,256
Washington	69,241	150	2,500	71,891
West Virginia		202,166	46,128	248,294
Wisconsin	194,402	342,568	12,304	549,274
Wyoming		1,100	2,709	3,809
Total	4,930,003	9,558,626	1,041,493	15,530,122

EXPORTS AND IMPORTS.

The following figures, compiled from statistics furnished by the Bureau of Statistics of the Department of Commerce and Labor, give the value of the exports and imports of stone for the calendar years 1903 and 1904:

Imports of stone into the United States in 1903 and 1904.

	1903.	1904.
Marble and stone, unmanufactured	$219,732	$203,086
Roofing slate	838,683	449,743
Lime	48,622	52,296
All others	629,901	684,925
Total	1,736,938	1,390,050

Exports of stone from the United States in 1903 and 1904.

	1903.	1904.
Marble:		
In block, rough, etc	$998,858	$851,841
Sawed or dressed	1,030	265
Slabs or paving tiles	107,701	55,020
All other manufactures	309,852	243,931
Mosaic cubes	33,483	35,128
Total	1,450,924	1,186,185
Lime, total	84,234	82,008
Onyx:		
In block, rough, etc	78,445	63,975
Sawed or dressed	1,297	....
Slabs or tiles	856	....
All other manufactures	4,052	10,885
Total	84,650	74,860
Granite:		
Dressed	96,925	111,543
Rough	3,651	7,573
Total	100,576	119,116
Slate:		
Roofing	2,266	....
Slabs, mantels, etc	8,754	9,845
Total	11,020	9,845
Stone (other):		
Dressed	12,796	24,680
Rough	15,374	15,974
Total	28,170	40,654
Grand total	1,759,574	1,512,668

As will be seen from these figures, the value of both exported and imported stone decreased in 1904 as compared with 1903. On page 829 of this report will be found a table showing the exports of slate according to the ports and customs districts, by fiscal years, for a series of years, as published by the Bureau of Statistics.

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 1904 the value of the granite output in the United States, including the above-mentioned classes of rocks, was $19,992,983. This, as compared with $18,436,087, the value for 1903, shows an increase of $1,556,896 for 1904. In 1903 the increase was but $178,143, or from $18,257,944 in 1902 to $18,436,087 in 1903. In 1903 the industry, especially in the eastern States, was disturbed by labor troubles, builders' strikes, and increased price of other materials in the large cities furnishing a market for this stone. The production of the year 1904 was also influenced by these troubles, but not so much as in 1903, and it is noteworthy that the principal increase in the granite output is for stone for building purposes and for the better class of stone—that is, for dressed stone. To some extent, especially in large cities, stone for foundation work has been done away with and concrete is used in its stead, and the increase in the value of stone used for concrete is therefore very natural. Massachusetts ranks first in value of granite output, followed by Vermont, Maine, California, Georgia, and New Hampshire.

In 1903 the order was Massachusetts, Maine, Vermont, California, Connecticut, and New Jersey.

A large increase in the figures for Vermont and Georgia, and a decrease in value for Maine and Connecticut, caused this change of rank.

There was an increase in the value of stone used for building purposes in 1904 of $748,280, or from $6,192,145 in 1903 to $6,940,425 in 1904. In 1903 there was a decrease of $842,687 in the value of this product.

Rough building stone sold by the quarrymen, however, decreased $466,891 in 1904, or from $1,671,929 in 1903 to $1,205,038 in 1904, while the stone dressed by the producers increased in value $1,215,171, or from $4,520,216 in 1903 to $5,735,387 in 1904.

The stone sold for monumental work in 1904, including the rough stock sold by the quarrymen for this purpose, was valued at $3,663,682; in 1903 this value was $3,808,417, a loss of $144,735 in 1904. The rough monumental stock was valued at $1,692,880 in 1903 and at $1,718,185 in 1904, an increase of $25,305. The dressed stone was valued at $2,115,537 in 1903 and at $1,945,497 in 1904, a decrease of $170,040.

The stone sold "rough for other purposes" includes in California, Delaware, South Carolina, and Texas a large quantity of stone used for jetty work and for breakwater.

The value of paving blocks increased slightly, from $1,954,266 in 1903 to $1,983,328 in 1904, a gain of $29,062.

The crushed stone increased in value from $3,780,487 in 1903 to $4,930,003 in 1904, a gain of $1,149,516.

The following tables show the value of the granite produced in the United States in 1903 and 1904 by States and uses:

Value of granite produced in the United States in 1903 and 1904, by States and uses.

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			
Arkansas								
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	103,353	828,508	579	346,293	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	853,224	4,520,216	2,115,537	1,954,266	701,018	91,142

Value of granite produced in United States in 1903 and 1904, by States and uses—Cont'd.

1903—Continued.

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	2,104	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	12,893	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		53,100		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

Value of granite produced in United States in 1903 and 1904, by States and uses—Cont'd.

1904.

State.	Sold in the rough.			Dressed for building.	Dressed for monumental work.	Made into paving blocks.	Curbing.	Flagging.
	Building.	Monumental.	Other.					
Arizona	....	....	....	....	$2,500	....	....	....
Arkansas	$100	$100	$100	....	....	....	$150	....
California	58,820	56,058	221,349	$360,734	99,151	$252,054	63,760	$350
Colorado	1,600	22,479	840	33,550	5,835	4,000	2,500	....
Connecticut	92,016	23,371	3,988	289,772	42,202	49,354	21,690	386
Delaware	26,328	14	45,220	8,909	270	13,031	4,392	276
Georgia	34,033	40,275	2,150	234,931	450	250,896	218,266	1,000
Idaho	....	....	....	....	....	....	....	....
Indian Territory	....	....	....	5,000	....	....	38	....
Maine	126,959	31,066	19,547	1,592,132	86,610	426,463	70,731	10,516
Maryland	124,994	15,037	3,450	270,791	8,139	46,864	14,970	19,001
Massachusetts	225,322	365,607	52,763	876,517	209,077	320,714	142,347	4,969
Minnesota	9,529	24,435	2,800	71,934	143,247	66,000	18,787	2,507
Mississippi	440	....	....	....	....	....	....	....
Missouri	....	16,681	521	18,680	6,335	31,786	5,002	....
Montana	4,890	3,100	....	9,500	7,200	3,000	700	....
Nevada	....	....	....	200	1,000	....	....	....
New Hampshire	124,186	74,478	12,314	393,144	214,578	65,151	16,807	1,003
New Jersey	9,930	1,030	....	27,499	2,079	28,535	....	....
New York	26,615	1,100	900	61,800	4,900	15,500	665	60
North Carolina	18,171	110	400	61,488	874	15,807	95,708	6,323
Oklahoma	60	1,060	....	240	10,240	....	120	....
Oregon	1,695	3,397	12	3,140	12,117	7,000	150	....
Pennsylvania	118,049	50	2,577	60,169	381	30,643	10,671	200
Rhode Island	12,643	118,236	1,000	214,599	153,930	47,823	2,350	375
South Carolina	47,104	23,895	132,349	60,753	6,882	5,945	20,365	1,260
South Dakota	100	300	....	500	....	....	....	....
Texas	11,230	20,726	141,214	56,646	23,885	....	130	....
Utah	506	1,606	....	....	500	....	....	....
Vermont	83,148	797,830	3,900	912,801	615,057	14,745	6,006	....
Virginia	33,613	17,320	....	48,452	55,608	30,966	33,324	3,516
Washington	11,600	3,552	1,000	57,520	26,390	3,000	16,743	800
Wisconsin	800	55,272	....	3,986	206,060	254,051	3,090	5,610
Wyoming	557	....	....	....	....	....	....	....
Total	1,205,038	1,718,185	648,394	5,735,387	1,945,497	1,983,328	769,462	58,152

Value of granite produced in United States in 1903 and 1904, by States and uses—Cont'd.

1904—Continued.

State.	Crushed stone.			Rubble.	Riprap.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.				
Arizona							$2,500
Arkansas	$10,450	$3,936	$20,180	$15,050	$2,550		52,616
California	215,431	171,569	223,053	17,456	935	$1,610	1,742,330
Colorado	20,228						91,132
Connecticut	177,842	45,183	76,272	7,812	24,886	10	854,784
Delaware	47,138	94,976	638	3,380	700		245,272
Georgia	9,422	57,228	50,630	42,285	300	600	942,466
Idaho							
Indian Territory			18	96			5,152
Maine	3,505		7,206	3,970	3,601	18,203	2,400,509
Maryland	128,672	5,537	137,102	31,155	3,881	5,878	815,471
Massachusetts	267,938	28,515	111,390	222,879	37,660	2,607	2,868,305
Minnesota	46,893		4,696	11,129	20	3,979	405,956
Mississippi							440
Missouri	31,119		38,692	400	2,030	4,470	155,716
Montana			500	5,000			33,890
Nevada							1,200
New Hampshire	11,856		3,665	1,910	6,515	1,880	927,487
New Jersey	570,679	74,567	114,527	14	2,328	2,330	833,518
New York	380,246	58,590	41,400	30,135		1,075	622,986
North Carolina	22,159	66,783	4,454	3,801	746	1,025	297,749
Oklahoma					15,060	150	26,930
Oregon	54,064	43,750	1,000	108,638	250		235,213
Pennsylvania	237,290	112,693	317,110	6,971	318	3,408	900,530
Rhode Island	55,673	35,025	39,875	3,120	248	55	684,952
South Carolina	16,669	25,555	30,669	5,502	5,480		382,428
South Dakota							900
Texas	35		70,372		23,594	485	348,317
Utah				5,000	368		7,980
Vermont	414	225	1,721	1,361	121	10,650	2,447,979
Virginia	12,940	61,352	165,043	40,524	7,630	500	510,788
Washington	10,629		58,612	196,181	36,481		422,508
Wisconsin	175,274	19,128		1,151			724,422
Wyoming							557
Total	2,506,566	904,612	1,518,825	764,920	175,702	58,915	19,992,983

The following table shows the value of the production of granite in the United States from 1900 to 1904, inclusive:

Value of granite produced in the United States, 1900–1904.

State.	1900.	1901.	1902.	1903.	1904.
Arizona			$3,000	$3,000	$2,500
Arkansas	$62,500	$23,554	12,115	47,136	52,616
California	738,993	1,134,675	1,137,679	1,627,592	1,742,330
Colorado	143,054	138,996	66,023	100,791	91,132
Connecticut	507,754	616,654	812,141	1,101,425	854,784
Delaware	608,028	671,204	276,753	369,166	245,272
Georgia	380,434	761,646	803,778	672,947	942,466
Idaho	2,450	5,100	12,910	2,750	
Indian Territory				4,030	5,152
Kansas	30,000	48,530			
Maine	1,568,573	2,703,116	2,659,450	2,586,765	2,400,509
Maryland	486,822	613,356	758,203	837,787	815,471
Massachusetts	1,698,605	2,216,258	3,451,397	2,720,066	2,868,305
Michigan	3,957	2,706			
Minnesota	221,684	260,105	478,989	403,906	405,956
Mississippi					440
Missiouri	139,103	95,806	157,708	150,409	155,716
Montana			77,050	25,993	33,890
Nevada	9,091	19,300	2,090	7,450	1,200
New Hampshire	870,646	935,494	1,147,097	854,513	927,487
New Jersey	1,170,555	894,167	948,474	943,171	833,518
New York	446,171	489,828	651,014	549,015	622,986
North Carolina	257,962	261,288	338,750	218,947	297,749
Oklahoma				5,000	26,930
Oregon	5,313	10,754	38,429	118,411	235,213
Pennsylvania	396,271	486,008	661,062	829,535	900,530
Rhode Island	444,316	501,698	734,623	710,291	684,952
South Carolina	500,802	996,084	598,848	476,863	382,428
South Dakota	114,115	99,941	(a)	(a)	900
Texas	76,069	27,005	60,003	173,325	348,317
Utah	2,170	5,588	1,479	3,803	7,980
Vermont	1,113,788	1,245,828	1,570,423	1,810,179	2,447,979
Virginia	211,080	275,701	282,046	299,335	510,788
Washington	48,900	43,808	147,273	209,095	422,508
Wisconsin	407,711	389,953	369,137	573,391	724,422
Wyoming	8,700	2,810			557
Total	12,675,617	15,976,961	18,257,944	18,436,087	19,992,983

[a] Value of quartzite included in sandstone.

The following tables show the value of the trap rock produced in the United States in 1903 and 1904, by States and uses:

Value of trap rock produced in the United States in 1903 and 1904, by States and uses.

1903.

State.	Building.	Paving.	Crushed stone.			Other.	Total.
			Road making.	Railroad ballast.	Concrete.		
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	30	369,039
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	129,324	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

1904.

State.	Building.	Paving.	Road making.	Railroad ballast.	Concrete.	Other.	Total.
California	$34,814	$74,464	$150,965	$106,403	$194,614	$655	$561,915
Connecticut	4,061	1,456	175,528	45,183	70,222	....	296,450
Massachusetts	25,022	....	203,958	11,628	72,949	....	313,557
New Jersey	14,003	28,535	566,679	72,877	112,127	2,100	796,321
New York	1,750	....	352,251	58,500	13,800	....	426,301
Pennsylvania	5,541	7,923	202,691	105,693	106,685	469	429,002
Total	85,191	112,378	1,652,072	400,284	570,397	3,224	2,823,546

From the above tables it will be seen that the value of trap rock increased $91,252, from $2,732,294 in 1903 to $2,823,546 in 1904. The increase was in crushed stone and paving stone, and from California, Connecticut, and New York; a decrease in value appearing from Massachusetts, New Jersey, and Pennsylvania.

In 1904 an endeavor was made to compile statistics showing the number of paving blocks made, as well as their value, and the following table gives the results obtained. In some cases, notably in Virginia, the number of blocks was based on an estimate, but the greater part of the figures were those given by the quarrymen themselves.

Number and value of paving blocks produced in 1904.

State.	Paving blocks.	
	Number.	Value.
California	5,534,250	$252,054
Colorado	53,150	4,000
Connecticut	1,464,656	49,354
Delaware	366,475	13,031
Georgia	6,677,265	250,896
Maine	9,808,465	426,463
Maryland	983,575	46,864
Massachusetts	5,678,562	320,714
Minnesota	1,004,325	66,000
Missouri	697,852	31,786
Montana	60,000	3,000
New Hampshire	1,892,260	65,151
New Jersey	1,246,100	28,535
New York	330,000	15,500
North Carolina	417,700	15,807
Oregon	190,000	7,000
Pennsylvania	677,688	30,643
Rhode Island	1,138,190	47,823
South Carolina	163,825	5,945
Vermont	382,758	14,745
Virginia	1,032,200	30,966
Washington	100,000	3,000
Wisconsin	4,277,333	254,051
Total	44,176,629	1,983,328

The paving blocks vary in price from $15 per thousand to about $80 per thousand, according to size and to regularity of shape.

In many cases, especially in the New England States, the paving blocks are cut from the refuse stone of the larger quarries, the cutter paying a small value for the rough stone, or paying a certain amount for every thousand cut. In some cases these men go around the country and blast and trim up bowlders and sell the blocks in case there is a demand for them. Many of these men are foreigners, and it is almost impossible to get a record of either the number or the value of the blocks they make except through the firms to which they sell, which are often the large quarrymen.

SANDSTONE.

The total value of the sandstone output in the United States in 1904 was $10,295,933; in 1903 the value was $11,262,259, a decrease of $966,326 for 1904. In 1903 there was an increase of $661,088 as compared with 1902, when the value was $10,601,171. These figures include bluestone quarried in New York and Pennsylvania, valued at $1,791,729 in 1904 and at $1,779,457 in 1903, an increase in 1904 of $12,272. The sandstone output, not including bluestone, decreased from $9,482,802 in 1903 to $8,504,204 in 1904, a loss of $978,598. In 1903 there was a slight increase over the figures for 1902.

The decrease was in the value of stone used for building purposes, which, including dressed and rough stone, was valued at $6,403,969 in 1903 and at $5,162,158 in 1904, a decrease of $1,241,811. The greater part of this decrease was in the State of Pennsylvania, which, on account of a decreased quantity of stone used for railroad bridge construction, showed a smaller output than in 1903.

Crushed stone increased in value from $827,585 in 1903 to $1,041,493 in 1904, an increase of $213,908, the increase being in the stone used for railroad ballast and roadmaking.

Stone used for riprap, rubble, paving, and flagstones decreased somewhat in value of production, while stone used for curbing increased somewhat in value.

In Pennsylvania, the State showing the largest value for sandstone, the value of the output decreased from $3,255,073 in 1903 to $2,641,510 in 1904, a loss of $613,563. This loss was chiefly in the value of stone used in construction of railroad bridges.

Ohio, the next State in rank as a sandstone producer, increased very slightly in 1904 in value of output—from $1,793,379 in 1903 to $1,808,062 in 1904, or a gain of $14,683.

The output of New York, the third State in rank, like that of Ohio, remained practically the same during the two years, being valued at $1,756,501 in 1903 and at $1,755,524 in 1904. The greater part of the New York output is bluestone, the value of which was reported as $1,026,968 in 1903 and as $1,044,314 in 1904.

California is the next State in rank, with an output valued at $735,662 in 1904 as compared with $762,327 in 1903, a decrease of $26,665.

Of the other sandstone-producing States Arizona showed the greatest change, the output declining in value from $526,875 in 1903 to $91,960 in 1904, a decline due to less railroad construction work.

The figures reported from Hawaii are for tufa stone used for road ballast, railroad work, and concrete.

The following tables show the value of the sandstone production of the United States in 1903 and 1904, by States and uses:

Value of sandstone produced in the United States in 1903 and 1904, by States and uses.

1903.

State.	Rough building.	Dressed building.	Crushed stone.			Ganister.	Riprap.
			Road-making.	Railroad ballast.	Concrete.		
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	...	...	803	...	...
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 1903 and 1904, by States and uses—Continued.

1903—Continued.

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						11,856
Illinois	4,400		374	50	181	26,293
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	68,036
Nebraska	10				27	1,067
Nevada	100	20		150		2,370
New Jersey			40	373		364,337
New Mexico	2,032		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		532,046	230,586	8,815	1,793,379
Oklahoma						6,500
Oregon	68					2,912
Pennsylvania	156,818	83,243	192,225	228,204	26,191	3,255,073
South Dakota	23,277	34,553		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		47,430
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	656,933	696,053	1,164,156	1,003,528	62,199	11,262,259

Value of sandstone produced in the United States in 1903 and 1904, by States and uses—Continued.

1904.

State.	Rough building.	Dressed building.	Crushed stone.			Ganister.	Riprap.
			Road-making.	Railroad ballast.	Concrete.		
Alabama							$6,796
Arizona	$19,050	$44,860			$1,580		170
Arkansas	6,676	3,709	$3,750		7,678		1,540
California	30,638	468,701	76,000	$36,221	375		1,626
Colorado	58,386	27,596			4,655	$5,000	5,087
Connecticut	108,130	9,255					271
Hawaii			3,133	10,000	8,909		
Idaho	4,725	4,150					25
Illinois	16,804	7,092	5,105	50	9,430	600	525
Indiana	5,940	11,160					1,150
Iowa	7,952	460	92	8			90
Kansas	22,338	7,481	4,175	44,494	1,161		179
Kentucky	41,751	14,622	2,550		400		600
Louisiana			810		500		
Maryland	4,192	150				4,656	
Massachusetts	60,691	43,950	155,960	525	57,254		
Michigan	47,593	14,818	1,400		400		
Minnesota	6,519	57,597	3,314	3,000	5,051		7,925
Missouri	12,553	17,130			220	10	6,058
Montana	7,683	45,099	169		1.500		3,157
Nebraska	90				32		
Nevada	1,000	9,000	400				
New Jersey	188,613	28,700	5,500		1,613		700
New Mexico	924	680		130,294	600		
New York	303,053	318,418	11,883	12,695	5,337		4,397
North Carolina		250					
Ohio	489,464	374,960	11,890	2,500	12,000	4,618	27,217
Oklahoma	725	1,800					
Oregon	5,505	123	111				
Pennsylvania	452,713	1,133,209	28,122	165,664	46,755	101,525	57,556
South Dakota	61,859	80,260	5,225	600	26,001		10,060
Tennessee	8,350	10,000	840		1,893		200
Texas	19,844	20,750			45,356		116,753
Utah	46,800	3,443					
Virginia	300	500		12,672			
Washington	30,750	29,080		2,500			5,915
West Virginia	73,384	98,411	8,327	27,119	10,682		7,560
Wisconsin	69,485	35,367	10,204	2,100		26,548	4,591
Wyoming	14,247	10,650	2,460		249		
Total	2,228,727	2,933,431	341,420	450,442	249,631	136,957	270,148

Value of sandstone produced in the United States in 1903 and 1904, by States and uses—Continued.

1904—Continued.

State.	Rubble.	Paving.	Flagging.	Curbing.	Other.	Total.
Alabama	$5,992					$12,788
Arizona	26,000				$300	91,960
Arkansas	3,950	$5,056	$4,008	$25,543	2,040	63,950
California	58,625			180	63,296	735,662
Colorado	52,277	1,850	78,872	42,720	4,699	281,142
Connecticut				40		117,696
Hawaii						22,042
Idaho	420					9,320
Illinois	4,012	2,500	153	290	816	47,377
Indiana	3,780	72	195	384		22,681
Iowa	415		190	88	5	9,300
Kansas	3,658	980	25,698	19,952	400	130,516
Kentucky	13,800	2,949	11,750	3,200	2,000	93,622
Louisiana	5,500	1,400		105		8,315
Maryland						8,998
Massachusetts	1,481				1,000	320,861
Michigan	10,657					74,868
Minnesota	24,834	160,129	5,751	44,102	987	319,209
Missouri	6,029		1,237	893	325	44,455
Montana	3,623		2,280	550	171	64,232
Nebraska	20					142
Nevada				158		10,558
New Jersey	10,000		500	800		236,426
New Mexico	842		50			133,390
New York	15,780	271,540	249,432	551,389	11,600	1,755,524
North Carolina						250
Ohio	71,808	500	512,381	296,589	4,135	1,808,062
Oklahoma	400			70		2,995
Oregon					447	6,186
Pennsylvania	99,947	72,761	227,318	246,658	9,282	2,641,510
South Dakota	23,606	122,665	375	6,114	2,205	338,970
Tennessee	2,490	60		65	970	24,868
Texas	6,000	35	65	420	90	209,313
Utah	2,705	12,400	100	4,020	700	70,168
Virginia	50					13,522
Washington	10,940	9,000				88,185
West Virginia	42,862		1,490	14,599	2,947	287,381
Wisconsin	14,360	165	268	23	1,392	158,503
Wyoming	2,240		750	40	350	30,986
Total	529,103	664,062	1,122,863	1,258,992	110,157	10,295,933

The following table shows the value of the sandstone production in the United States from 1900 to 1904, inclusive, by States:

Value of sandstone production in the United States, 1900–1904, by States.

State.	1900.	1901.	1902.	1903.	1904.
Alabama	$7,132	$8,680	$42,706	$42,933	$12,788
Arizona	64,000	202,500	107,910	526,875	91,960
Arkansas	104,923	62,825	85,917	61,172	63,950
California	200,090	301,028	462,328	762,327	735,662
Colorado	119,658	237,331	366,161	389,132	281,142
Connecticut	192,593	146,814	128,579	119,417	117,696
Georgia	600	....	1,250	....	....
Hawaii	....	....	6,688	....	22,042
Idaho	438	20,843	13,777	11,856	9,320
Illinois	19,141	12,884	32,200	26,293	47,377
Indiana	45,063	28,334	37,593	32,651	22,681
Iowa	19,063	14,341	15,061	19,011	9,300
Kansas	55,173	49,901	105,509	102,128	130,516
Kentucky	56,178	108,259	128,470	93,742	93,622
Louisiana	[a]118,192	....	....	....	8,315
Maryland	6,655	4,546	15,405	2,170	8,998
Massachusetts	153,427	247,310	487,366	372,478	320,861
Michigan	238,650	174,428	188,073	121,350	74,868
Minnesota	267,000	246,685	347,472	363,262	319,209
Missouri	53,401	42,170	56,990	49,402	44,455
Montana	59,630	58,439	85,152	68,036	64,232
Nebraska	....	515	168	1,067	142
Nevada	....	....	6,115	2,370	10,558
New Jersey	198,234	244,512	406,726	364,337	236,426
New Mexico	2,500	....	12,291	7,510	133,390
New York	[b]1,467,496	[b]1,331,327	[b]1,408,699	[b]1,756,501	[b]1,755,524
North Carolina	27,210	11,682	4,825	600	250
Ohio	2,233,596	1,999,180	2,078,754	1,793,379	1,808,062
Oklahoma	....	....	25,309	6,500	2,995
Oregon	5,450	531		2,912	6,186
Pennsylvania	[b]1,050,248	[b]2,063,082	[b]2,800,108	[b]3,255,073	[b]2,641,510
South Dakota	12,675	17,647	110,789	163,067	338,970
Tennessee	11,300	10,342	7,670	20,649	24,868
Texas	37,038	111,568	165,565	114,381	209,313
Utah	66,733	38,919	105,011	71,279	70,168
Virginia	6,000	5,303	2,500	4,471	13,522
Washington	68,133	89,174	30,725	47,430	88,185
West Virginia	72,438	103,010	423,532	252,204	287,381
Wisconsin	81,571	90,425	207,086	142,445	158,503
Wyoming	27,671	54,145	90,691	91,849	30,986
Total	7,149,300	8,138,680	10,601,171	11,262,259	10,295,933

[a] Includes Mississippi. [b] Includes bluestone.

The following table shows the value and uses of the bluestone produced in New York and Pennsylvania in 1903 and 1904:

Value and uses of bluestone produced in New York and Pennsylvania in 1903 and 1904.

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	85,512	1,779,457

1904.

State.	Building purposes.	Flagging.	Curbing.	Crushed stone.	Other purposes.	Total value.
New York	$482,908	$241,062	$295,064	$10,425	$14,855	$1,044,314
Pennsylvania	287,685	216,251	149,491	29,842	64,146	747,415
Total	770,593	457,313	444,555	40,267	79,001	1,791,729

SLATE.

In 1903, owing to strikes and various troubles in the building trades, the production of slate in the United States suffered somewhat of a check, the chief slate producers reporting for the last months of that year a much decreased demand. These conditions held also for the beginning of 1904, and the output for 1904 was less on that account. The total value of the output in 1903 was $6,256,885, and in 1904 it was $5,617,195, a decrease of $639,690. In 1903 the increase in value of production was $560,834, from $5,696,051 in 1902 to $6,256,885 in 1903.

In 1903, as compared with 1902, there was a decrease in the number of squares of slate produced with an increase in their value, the output being 1,435,168 squares valued at $4,950,428 in 1902, and 1,378,194 squares valued at $5,400,078 in 1903, an increase in value of $449,650 and a decrease in the number of squares of 56,974.

In 1904, as compared with 1903, there was a decrease both in the number of squares and in their value from 1,378,194 squares of slate valued at $5,400,078 in 1903 to 1,233,757 squares valued at $4,669,289 in 1904, a loss of 144,437 in the number of squares produced and of $730,789 in their value. The average price per square was $3.91 in 1903 and $3.78 in 1904, a decrease of 13 cents per square, though the prices remained much steadier in 1904 than in 1903.

The value of milled stock increased $91,099 in 1904 as compared with 1903, from $856,807 in 1903 to $947,906 in 1904. All the producers reported a good demand for this class of slate, although Pennsylvania was the only State showing any advance in value. In 1904

Georgia, Tennessee, and Utah reported a small output from quarries not worked for commercial purposes in 1903. New Jersey reported no production. Work was done on the development of quarries in Arizona, Colorado, North Carolina, and West Virginia, the slate in Arizona being first discovered in 1904.

The following table shows the value of roofing and milled slate quarried in the United States in 1903 and 1904, by States:

Value of roofing and mill slate produced in the United States in 1903 and 1904, by States.

1903.

State.	Roofing slate. Number of squares.	Roofing slate. 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	7,647	33,403	....	33,403
New York	15,690	89,548	22,450	111,998
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

1904.

State.	Roofing slate. Number of squares.	Roofing slate. Value.	Value of milled stock.	Total value.
Arkansas	1,750	$10,300	$4,000	$14,300
California	5,600	39,200	....	39,200
Georgia	1,000	4,500	....	4,500
Maine	20,789	120,838	60,330	181,168
Maryland	22,628	131,245	2,727	133,972
New York	10,022	64,102	7,441	71,543
Pennsylvania	778,825	2,922,259	710,987	3,633,246
Tennessee	115	607	....	607
Utah	50	300	....	300
Vermont	361,126	1,245,730	162,421	1,408,151
Virginia	31,852	130,208	....	130,208
Total	1,233,757	4,669,289	947,906	5,617,195

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	1898	$3.42
1891	3.49	1899	3.14
1892	3.56	1900	3.01
1893	3.55	1901	3.15
1894	3.11	1902	3.45
1895	3.23	1903	3.91
1896	3.36	1904	3.78
1897	3.09		

The following table shows the total value of the slate production of the United States from 1900 to 1904, inclusive:

Value of slate produced in the United States, 1900–1904.

State.	1900.	1901.	1902.	1903.	1904.
Arkansas			$4,000	$4,709	$14,300
California	$26,500	$18,608	31,500	70,000	39,200
Georgia	9,375	3,000	4,000		4,500
Maine	177,342	202,325	206,558	231,230	181,168
Maryland	128,673	105,798	118,084	137,631	133,972
Minnesota	700	1,400			
New Jersey	13,600	30,000	32,000	33,403	
New York	62,755	100,960	126,718	111,998	71,543
Pennsylvania	2,713,598	2,984,264	3,547,322	3,959,906	3,633,246
Tennessee	250				607
Utah					300
Vermont	917,462	1,162,191	1,464,918	1,592,652	1,408,151
Virginia	190,211	178,979	160,951	115,356	130,208
Total	4,240,466	4,787,525	5,696,051	6,256,885	5,617,195

The following table shows the value per square at the beginning of 1905 of the various kinds of No. 1 slate. The figures were compiled from information sent in by the producers and represent the value free on board at the quarry:

Value per square January 1, 1905, of No. 1 slate free on board at quarry.

Number per square.	Size.	Monson, Me., No. 1.	New York red.	Maryland and Pennsylvania Peach Bottom.	Pennsylvania.									Vermont.				Virginia.
					Bangor No. 1.	Bangor ribbon No. 1.	Albion No. 1.	Pen Argyl.	Hard vein.	Danielsville.	Chapman.	Slatington unfading big bed.	Franklin unfading big bed.	Unfading.	Sea green.	Intermediate sea green.	Purple vein.	
	Inch.																	
686	9×7	$3.50	$6.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
588	10×7	.....	7.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	$4.00	.....	.....	.....	.....
515	10×8	4.00	7.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.00	.....	.....	.....	.....
450	11×8	4.50	8.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
534	12×6	4.50	9.50	.....	$4.50	.....	$4.25	$4.00	$3.50	.....	.....	$3.25	$3.50	4.50 4.00	$2.50	.....	$2.50	.....
458	12×7	5.00	9.50	.....	4.50	.....	4.25	4.25	3.50	.....	.....	.....	3.75	4.50 4.00	2.50	.....	.....	.....
400	12×8	5.50	9.50	.....	4.50	$4.25	4.25	4.25	.....	.....	.....	3.75	4.00	4.50 4.00	3.25	.....	.....	.....
356	12×9	5.60	9.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.50 4.00	3.25	.....	3.25	.....
320	12×10	5.80	9.50	.....	4.50	.....	.....	.....	.....	.....	.....	.....	.....	4.50	3.25	.....	3.25	.....
267	12×12	.....	.....	.....	6.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
374	14×7	6.40	11.00	$6.00	4.75	4.25	4.50	4.25	4.50	.....	.....	4.25	4.50	5.25	3.25	.....	3.25	.....
328	14×8	6.60	11.00	6.00	4.75	4.25	4.50	4.25	4.50	.....	.....	4.25	4.50	5.25	3.50	$2.60	3.50	.....
291	14×9	6.50	11.00	6.25	.....	.....	.....	.....	.....	.....	.....	4.25	4.50	5.25	3.50	2.60	3.50	.....
262	14×10	6.60	11.00	6.25	4.75	4.25	4.50	4.50	.....	.....	.....	4.25	4.50	5.25	3.50	2.60	3.50	.....
219	14×12	6.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.50	2.60	3.50	.....
187	14×14	.....	11.00	.....	6.00	.....	5.50	.....	.....	.....	.....	4.75 4.50	.....	.....	.....	.....	.....	.....
277	16×8	7.20	11.00	6.35	5.75	4.25	5.00	4.75	4.50	$4.25	$5.25	.....	5.00	5.25 4.50	3.50	2.90	3.50	$5.00 5.50
247	16×9	7.00	11.00	6.35	5.25	.....	5.00	4.75	4.50	.....	.....	4.75	5.00	5.25	3.50	2.90	3.50	.....
222	16×10	7.10	11.00	6.35	5.25	4.25	5.00	4.75	.....	.....	.....	4.75	5.00	5.25	3.70	2.90	.....	.....
202	16×11	6.90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
185	16×12	6.80	.....	.....	4.50	4.00	4.25	4.50	.....	.....	.....	.....	5.00	5.25	3.70	2.90	.....	.....
139	16×16	.....	11.00	.....	6.00	.....	5.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
214	18×9	7.10	11.00	6.35	5.75	4.25	5.00	4.75	4.50	.....	.....	.....	5.00	5.25	3.70	2.90	3.70	.....
192	18×10	7.20	11.00	6.35	5.25	4.25	5.00	4.75	4.50	.....	.....	4.75	5.00	5.25	3.80	2.90	3.80	.....
175	18×11	7.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.25	3.70	2.90	3.70	.....
160	18×12	6.80	.....	6.25	4.50	4.00	4.25	4.50	.....	.....	.....	.....	5.00	5.25	3.70	2.90	3.70	.....
...	18×18	.....	.....	.....	6.00	.....	5.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
170	20×10	6.80	11.00	6.35	5.25	4.00	5.00	4.75	4.50	.....	.....	4.75	5.00	5.50 5.25	4.00	2.90	4.00	.....
154	20×11	6.80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5.25	3.80	2.90	3.80	.....
142	20×12	6.90	.....	6.25	4.50	4.00	4.25	4.50	.....	.....	.....	.....	.....	5.25	3.80	2.90	3.80	.....
121	20×14	6.90	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.50	4.75	.....	3.70	2.90	.....	.....
138	22×11	6.50	.....	6.25	4.75	4.00	4.50	4.50	4.25	.....	.....	4.50	4.75	5.25 4.50	4.00	2.90	4.00	.....
127	22×12	6.60	.....	6.25	4.50	4.00	4.25	4.50	.....	.....	.....	4.50	4.65	5.25 4.50	3.80	2.90	3.80	.....
108	22×14	6.60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.70	2.90	3.70	.....
115	24×12	6.60	.....	6.25	4.50	4.00	4.25	.....	4.00	.....	.....	4.25	4.50	5.25 4.50	4.00	2.90	4.00	.....
98	24×14	6.50	.....	6.00	4.50	3.80	4.25	4.25	.....	.....	.....	4.25	4.50	4.50	3.80	2.90	3.20	.....
...	26×14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.00	.....	4.00	.....
...	28×14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.00	.....	4.00	.....

A "square" of slate is the number of slate required to lay 100 square feet of roof, allowing a 3-inch lap. The estimated weight of roofing slate of ordinary thickness is 650 pounds to the square, and the slate is generally shipped in carload lots of from 50 to 90 squares per carload.

The prices per square vary from month to month, and the freight rates vary according to place of shipment, ranging from $1 to $1.75 per square to places west of Pittsburg and east of the Mississippi River, and to nearly $8 per square delivered in San Francisco.

EXPORTS.

The exports of roofing slate increased, according to the figures of the Bureau of Statistics, Department of Commerce and Labor, from $628,612 in the fiscal year ending June 30, 1903, to $726,715 in 1904, an increase of $98,103. There was a slight increase in the slate exported to the United Kingdom, which was valued at $477,251 in 1903, and at $515,085 in 1904.

The figures for the fiscal year are used in the following table instead of for the calendar year, because the details by ports and customs districts are not given by the Bureau of Statistics for any other periods except fiscal years.

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 1895–1904.

Port and customs district.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Baltimore, Md		$9,860	$101,581	$170,916	$99,083	$110,049	$135,571	$240,734	$221,933	$275,393
Bangor, Me		350				577	1,144	449	1,170	30
Belfast, Me								375		
Boston and Charlestown, Mass	$443	609	1,020	385	40,622	65,531	93,972	48,299	30,273	29,175
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	284,750
Passamaquoddy, Me	192		120					160		
Philadelphia, Pa		2,300	94,865	136,916	205,779	150,254	236,090	243,701	120,240	97,247
Portland and Falmouth, Me			270							378
Brazos de Santiago, Tex					14					
Corpus Christi, Tex	105	174		1,761				44		505
New Orleans, La										
Paso del Norte, Tex								20		580
Puget Sound, Wash				22	67		1,436	1,343	1,504	1,445
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	29,034
Champlain, N. Y	1,961	1,617	613	3,015	937	2,320	2,446	6,561	5,771	4,185
Detroit, Mich	65	2,874	2,427	854	129	1,441	380			669
Huron, Mich						424				

Exports of slate from the United States, showing ports and customs districts from which and to which sent, in the fiscal years 1895–1904—Continued.

Port and customs district.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Memphremagog, Vt.							$644	$246		
North and South Dakota				$137		$612	942			
Oswegatchie, N. Y.						487	4,915	3,702	$3,714	$3,007
Vermont	$200	$139	$1,569			26	9			317
Total	38,806	266,385	780,112	1,370,075	$1,363,617	950,543	898,262	945,352	628,612	726,715
Belgium					524				89	
France		12,000								379
Germany	25	910	5,850	82,916	65,974	17,921	5,180	1,555		1,440
Netherlands			2,087	25	520		600	1,400		8,298
United Kingdom	3,000	197,440	695,980	1,213,377	1,188,962	813,918	727,088	731,556	477,251	515,085
Denmark				8,150	25,323	25,437	43,344	47,957	17,376	32,512
Norway and Sweden				270	669	859	1,857	25		
Bermuda	1,550	2,312	1,395	157	230	202	3,222	443	765	378
Dominion of Canada:										
Nova Scotia, New Brunswick, etc	406	1,278	730		288	798	1,269	532	1,183	240
Quebec, Ontario, etc	6,974	10,533	6,977	8,147	7,430	11,894	27,587	28,600	44,670	37,242
British Columbia				22	67		2,378	1,343	1,504	1,445
Newfoundland and Labrador	13					30				59
Central American States:										
Costa Rica								1,268	423	
Guatemala				1,755						
Honduras										
Nicaragua										115
Mexico	488	821	150	1,872	330		20	854	479	1,085
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	4,212
Haiti				26		332			52	132
Santo Domingo	10									
Cuba	3,258	90		673	16					
Brazil										761
Colombia		259	100			285				
Ecuador										251
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						49
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	120,832
British Oceania									1,222	
Hawaiian Islands		245	166		77					
British Africa, South	258	1,883	1,598	2,218	4,335	2,458	4,847	679	1,499	2,200
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	726,715

MARBLE.

The production of marble in the United States increased in value from $5,362,686 in 1903 to $6,297,835 in 1904, or $935,149. The increase was in the dressed monumental stone and in the stone used for the interior of buildings.

The chief increase was from the States of Georgia, Massachusetts, Tennessee, and Vermont.

Alaska and Arkansas, with no production in 1903, reported small productions in 1904.

Builders' strikes to some extent disturbed the trade, but not so much as in 1903. There were also strikes at some of the principal quarries.

The following table shows the value of the marble produced in the United States from 1900 to 1904, inclusive, by States:

Value of marble produced in the United States 1900–1904, by States.

State.	1900.	1901.	1902.	1903.	1904.
Alabama	$500		(a)	(a)	(a)
Alaska		$4,500			(a)
Arizona	5,000	300		(a)	(a)
Arkansas		300	(a)		(a)
California	17,500	6,642	$92,298	$78,329	$87,659
Connecticut			(a)	(a)	(a)
Georgia	631,241	936,549	660,517	565,605	690,714
Idaho	1,250				
Maryland	70,000	68,100	(a)	83,672	73,814
Massachusetts	130,735	126,546	165,489	154,228	183,388
Missouri	900	2,100		(a)	(a)
Montana	1,200	1,500	(a)		
New Mexico	4,500	10,600	(a)	(a)	4,250
New York	332,518	379,159	577,298	748,160	565,987
North Carolina				4,365	2,741
Oregon		500			
Pennsylvania	151,167	157,547	160,423	93,200	90,390
Tennessee	424,054	494,637	518,256	485,905	505,259
Utah		320	(a)	3,200	3,950
Vermont	2,484,852	2,753,583	2,628,164	3,011,505	4,004,669
Washington	11,836	22,816	61,176	40,117	23,098
Wyoming				3,100	2,000
Other States			[b] 180,561	[c] 91,300	[d] 59,916
Total	4,267,253	4,965,699	5,044,182	5,362,686	6,297,835

[a] Included in "Other States."
[b] Includes Alabama, Arkansas, Connecticut, Maryland, Montana, New Mexico, and Utah.
[c] Includes Alabama, Arizona, Connecticut, Missouri, and New Mexico.
[d] Includes Alabama, Alaska, Arizona, Arkansas, Connecticut, and Missouri.

The following table shows the various uses to which the marble quarried in 1900, 1901, 1902, 1903, and 1904 was put:

Distribution and value of output of marble in 1900, 1901, 1902, 1903, and 1904 among various uses.

Use.	1900.	1901.	1902.	1903.	1904.
Sold by producers in rough state	$491,813	$591,667	$2,276,629	$2,454,263	$2,599,052
Dressed for building	1,080,969	1,236,023	1,038,102	1,111,072	988,671
Ornamental purposes	13,754	126,576	7,300	51,359	21,554
Dressed for monumental work	2,019,474	1,948,892	956,870	1,062,339	1,211,389
Interior decoration in buildings	555,092	1,008,482	679,913	663,553	1,257,963
Other uses	106,151	54,059	85,268	20,100	219,206
Total	4,267,253	4,965,699	5,044,082	5,362,686	6,297,835

The following table shows the value of the marble produced in the United States in 1903 and 1904, by States and uses:

Value of the marble product, 1903 and 1904, by States and uses.

1903.

State.	Rough.			Dressed.					Other purposes.	Total.
	Building.	Monumental.	Other.	Building.	Monumental.	Ornamental.	Interior decoration.	Other purposes.		
Alabama										(a)
Arizona										(a)
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)
New Mexico										(a)
New York	199,027	64	7,595	362,040	179,434					748,160
North Carolina		4,365								4,365
Pennsylvania	5,090	200	194	56,866	27,000				3,850	93,200
Tennessee	94,500	15,000	125,279	134,226	3,500		99,600	13,700	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							3,100			3,100
Other States	6,400		4,700	80,000	100	100				b 91,300
Total	1,110,585	896,604	450,595	1,107,551	1,062,339	51,359	663,553	15,900	4,200	5,362,686

Value of the marble product, 1903 and 1904, by States and uses—Continued.

1904.

State.	Rough.			Dressed.					Other purposes.	Total.
	Building.	Monumental.	Other.	Building.	Monumental.	Ornamental.	Interior decoration.	Other purposes.		
Alabama										(a)
Alaska										(a)
Arizona										(a)
Arkansas										(a)
California	$4,810	$6,073		$7,800		$2,356	$66,620			$87,659
Connecticut										(a)
Georgia	283,223	227,491	$12,000	108,000					$60,000	690,714
Maryland	50,000	23,814								73,814
Massachusetts	17,000		14,638	79,472	$1,500	2,000	30,415	$38,363		183,388
Missouri										(a)
New Mexico	600			450		200			3,000	4,250
New York	89,971	115,003	10,360	287,830	59,323		3,500			565,987
North Carolina					2,741					2,741
Pennsylvania	9,031	700	3,200	38,459	24,000		10,000	5,000		90,390
Tennessee	53,450	15,000	149,850	50,000	12,000		215,959	9,000		505,259
Utah	200	750			3,000					3,950
Vermont	732,890	724,812	6,520	397,360	1,100,825	14,750	926,969	100,543		4,004,669
Washington	5,000	3,000	1,100	4,000	5,000	498	3,000	1,500		23,098
Wyoming	2,000									2,000
Other States	36,566			15,300	3,000	1,750	1,500	1,800		[c] 59,916
Total	1,284,741	1,116,643	197,668	988,671	1,211,389	21,554	1,257,963	156,206	63,000	6,297,835

[a] Included in "Other States."
[b] Includes Alabama, Arizona, Connecticut, Missouri, and New Mexico.
[c] Includes Alabama, Alaska, Arizona, Arkansas, Connecticut, and Missouri.

LIMESTONE.

The limestone production in the United States in 1904 was valued at $31,996,415, in 1903 at $31,537,991—a gain of $458,424 in 1904. In 1903 the total gain was $1,306,988, from $30,231,003 in 1902 to $31,537,991 in 1903. In 1902 the increase over 1901 was $3,824,106.

The comparatively small increases in 1903 and 1904 were due to labor troubles and strikes in the building trades. In 1904 the value of building stone decreased from $4,981,241 in 1903 to $4,543,760 in 1904, a loss of $437,481.

The value of lime increased from $9,255,882 in 1903 to $9,817,451 in 1904, a gain of $561,569.

The value of crushed limestone in 1904 was $9,558,626, a gain of $977,760 as compared with 1903, when the value was $8,580,866.

The furnace flux decreased in value from $5,423,732 in 1903 to $4,702,768 in 1904, a loss of $720,964.

The most important States in value of production were Pennsylvania, Ohio, Illinois, Indiana, Missouri, New York, and Wisconsin, in the order named, ranking as in 1903, except that Missouri and New York changed places.

A large quantity of limestone used for Portland cement is not included in the total.

The lime industry has been somewhat affected by the use of cement plaster in place of lime.

The following tables show the value of the production of limestone in the United States in 1903 and 1904, by States and uses:

Value of the production of limestone in the United States in 1903 and 1904, by States and uses.

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	40,988	
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	530		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				13,051	
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				64,998	
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	555,314	4,180
Wyoming	150				12,033	
Total	4,981,241	166,961	355,167	515,760	9,255,882	411,016

Value of the production of limestone in the United States in 1903 and 1904, by States and uses—Continued.

1903—Continued.

State.	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	736,590
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	136,903	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	190,608
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		148,416				243,135	30	558,024
Wisconsin	244,132	18,009	67,037	37,349	47,110	51,116	11,528	1,256,661
Wyoming								12,183
Total	2,997,547	3,105,602	2,477,717	959,175	555,365	5,423,732	422,826	31,627,991

Value of the production of limestone in the United States in 1903 and 1904, by States, and uses—Continued.

1904.

State.	Rough building.	Dressed building.	Flagging.	Curbing.	Paving.	Lime made.	Stone sold to lime burners.
Alabama		$34,344				$236,805	$320
Arizona						12,200	
Arkansas	$6,615	46,765		$830		142,713	
California	2,400			125	$100	585,486	49,430
Colorado						34,360	18,692
Connecticut						168,107	
Florida	778	8,000				55,085	
Georgia						58,772	
Idaho						40,142	5,900
Illinois	212,477	53,804	$18,401	17,084	4,985	461,068	7,575
Indiana	1,116,928	942,458	30,085	105,151	9,658	351,179	
Indian Territory						194	
Iowa	149,215	18,259	3,556	5,414	3,181	91,008	15
Kansas	109,152	48,932	8,337	24,706	726	10,770	
Kentucky	68,826	65,955	1,718	24,980	1,500	25,880	
Maine						799,517	
Maryland	12,836		80	241	715	309,079	2,466
Massachusetts	2,375					322,141	
Michigan	32,941	805			37,665	258,905	180,683
Minnesota	108,798	102,819	11,104	6,296	6,018	73,763	4,800
Missouri	139,502	271,416	7,712	8,477	2,400	597,258	50
Montana	3,045					24,150	
Nebraska	30,969	1,592	165	261	12		9,578
Nevada						2,700	
New Jersey	3,025	150				150,198	6
New Mexico						3,383	
New York	174,099	42,803	4,708	7,221	11,147	396,281	271,105
North Carolina						4,800	
Ohio	272,941	9,291	4,669	3,563	4,186	989,693	448
Oklahoma	12,359	6,210	5,550	1,392		3,000	
Oregon	2,000	740		150		10,191	
Pennsylvania	146,868	4,311	4.129	6,773	82,502	1,537,673	22,613
Rhode Island						31,871	
South Carolina						32,859	
South Dakota	926					23,960	
Tennessee	19,039	10,410	400	4,997	1,000	217,064	
Texas	40,435	21,430	1,677	5,994		134,316	
Utah	4,897	300				85,500	17,370
Vermont	5,000					184,681	
Virginia	8,800	360				277,519	
Washington	125				1,486	216,454	4,906
West Virginia	10					184,060	13,592
Wisconsin	156,687	5,878	5,738	56,591	19,389	670,391	200
Wyoming	2,660					2,275	3,900
Total	2,846,728	1,697,032	108,029	280,246	186,670	9,817,451	613,649

Value of the production of limestone in the United States in 1903 and 1904, by State and uses—Continued.

1904—Continued.

State.	Crushed stone.			Rubble.	Riprap.	Flux.	Other.	Total.
	Road making.	Railroad ballast.	Concrete.					
Alabama	$7,915	$908	$8,533	....	$85,200	$361,503	....	$735,528
Arizona	....	....	....	....	....	....	$250	12,450
Arkansas	33,750	3,100	2,200	$12,012	800	....	75	248,860
California	5,650	3,100	5,325	....	....	140	8,400	660,156
Colorado	....	....	....	....	3,150	102,758	....	158,960
Connecticut	....	....	....	....	....	830	....	168,937
Florida	300	....	....	200	25,000	....	....	89,363
Georgia	....	11,200	4,000	....	....	....	....	73,972
Idaho	....	....	....	....	....	....	....	46,042
Illinois	641,387	297,863	627,942	357,517	124,541	324,998	2,248	3,151,890
Indiana	254,258	77,923	51,002	40,195	15,347	128,556	17,939	3,140,679
Indian Territory	....	2,242	3,834	....	....	....	....	6,270
Iowa	53,082	5,549	76,790	79,485	43,394	....	4,645	533,593
Kansas	45,949	418,438	56,735	52,486	32,756	....	1,069	810,056
Kentucky	186,796	280,489	30,959	9,690	8,494	9,420	3,590	718,297
Maine	....	....	....	....	....	....	2,955	802,472
Maryland	31,144	34,837	45,166	265	....	34	637	437,500
Massachusetts	....	....	....	....	....	5,191	....	329,707
Michigan	58,655	57,100	60,745	2,800	2,405	62,586	5,323	760,613
Minnesota	43,036	11,550	92,910	92,830	29,424	100	8,255	591,703
Missouri	471,254	437,334	460,767	255,308	178,756	9,460	35,533	2,875,227
Montana	....	....	....	250	....	106,470	....	133,915
Nebraska	16,065	34,273	61,873	47,512	26,297	5,150	3,033	236,780
Nevada	....	....	....	....	....	....	....	2,700
New Jersey	2,984	....	....	1,200	....	65,922	3,423	226,908
New Mexico	....	....	....	....	....	....	....	3,383
New York	418,661	257,231	272,471	20,755	9,461	130,251	16,342	2,032,536
North Carolina	12,088	....	....	....	....	....	....	16,888
Ohio	765,603	361,850	217,961	21,311	97,794	588,579	58,159	3,396,048
Oklahoma	20	60,000	....	4,765	800	....	1,150	95,246
Oregon	....	....	....	2,500	....	....	....	15,581
Pennsylvania	344,953	555,839	381,200	4,301	4,174	2,058,018	93,069	5,246,423
Rhode Island	....	....	....	....	....	312	....	32,183
South Carolina	125	....	....	....	....	100	....	33,084
South Dakota	....	....	2,400	....	600	28	....	27,914
Tennessee	60,736	68,944	17,324	13,336	6,687	82,573	2,607	505,117
Texas	15,418	19,060	8,171	7,624	66,930	64,072	1,934	387,061
Utah	5,995	6,000	1,200	900	....	133,685	100	255,947
Vermont	931	....	3,300	9	....	413	....	194,334
Virginia	210	32,371	5,668	168	....	117,882	....	442,978
Washington	....	150	....	....	....	65,085	105	288,311
West Virginia	42,965	98,105	61,096	....	....	244,535	....	644,363
Wisconsin	195,057	17,546	129,965	41,039	30,084	30,867	49,643	1,409,075
Wyoming	....	....	1,100	....	180	3,250	4,000	17,365
Total	3,714,987	3,153,002	2,690,637	1,068,458	792,274	4,702,768	324,484	31,996,415

The following table shows the production of limestone in the United States from 1900 to 1904, by States:

Value of limestone, 1900–1904, by States.

State.	1900.	1901.	1902.	1903.	1904.
Alabama	$533,608	$619,423	$759,617	$719,404	$735,528
Arizona	165	300	....	1,260	12,450
Arkansas	71,407	68,319	113,163	242,628	248,860
California	407,489	645,455	496,843	611,126	660,156
Colorado	160,587	245,799	203,700	218,120	158,960
Connecticut	148,060	140,424	205,371	154,536	168,937
Florida	128,381	51,870	63,571	64,893	89,363
Georgia	54,451	85,629	111,589	73,352	73,972
Idaho	34,587	21,251	15,074	18,952	46,042
Illinois	1,881,151	2,793,837	3,222,608	3,206,271	3,151,890
Indiana	2,344,818	2,993,186	2,865,691	2,935,274	3,140,679
Indian Territory	....	....	....	1,450	6,270
Iowa	586,410	777,484	649,984	635,431	533,593
Kansas	339,466	478,986	670,536	495,069	810,056
Kentucky	178,252	199,567	593,747	736,590	718,297
Maine	691,312	715,272	745,132	793,553	802,472
Maryland	317,207	382,381	453,030	386,226	437,500
Massachusetts	209,359	244,039	339,349	272,471	329,707
Michigan	425,636	565,931	621,380	609,082	760,613
Minnesota	441,554	522,778	830,857	676,090	591,703
Missouri	1,079,343	1,362,272	1,697,139	2,516,688	2,875,227
Montana	141,093	143,866	104,725	152,694	133,915
Nebraska	107,305	154,717	145,473	187,718	236,780
Nevada	....	....	2,800	2,400	2,700
New Jersey	170,006	309,738	181,650	187,711	226,908
New Mexico	....	....	....	1,000	3,383
New York	1,730,162	1,738,716	2,419,121	2,543,756	2,032,536
North Carolina	....	8,266	23,153	600	16,888
Ohio	1,969,387	2,606,502	3,201,718	3,320,672	3,396,048
Oklahoma	25,586	32,497	50,541	54,690	95,246
Oregon	10,900	24,520	20,133	16,684	15,581
Pennsylvania	3,800,318	5,081,387	5,420,287	5,775,506	5,246,423
Rhode Island	16,828	38,030	71,664	39,315	32,183
South Carolina	38,415	28,500		44,780	33,084
South Dakota	47,762	53,780	86,605	39,266	27,914
Tennessee	238,505	330,927	482,033	555,574	505,117
Texas	124,728	209,658	228,662	262,053	387,061
Utah	12,749	78,909	186,663	100,608	255,947
Vermont	188,100	205,138	225,703	190,724	194,334
Virginia	403,318	539,128	534,113	569,205	442,978
Washington	249,163	234,587	213,814	297,701	288,311
West Virginia	53,701	447,049	616,366	558,024	644,363
Wisconsin	989,685	1,225,448	1,351,058	1,256,661	1,409,075
Wyoming	3,065	1,340	6,340	12,183	17,365
Total	20,354,019	26,406,897	30,231,003	31,537,991	31,996,415

The following table shows the quantity and value of blast-furnace flux produced in 1903 and 1904, by States:

Production of blast-furnace flux in 1903 and 1904, by States.

[Long tons.]

State.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
Alabama	1,006,814	$144,735	759,331	$361,503
California	8,410	5,705	140	140
Colorado	353,849	160,240	215,101	102,758
Connecticut	3,698	1,968	2,305	830
Illinois	491,542	246,379	686,958	324,998
Indiana	400,268	155,209	298,913	128,556
Kentucky	33,836	16,478	18,070	9,420
Maryland	490	200	78	34
Massachusetts	6,792	4,891	13,678	5,191
Michigan	23,518	15,502	136,293	62,586
Minnesota	500	250	200	100
Missouri	25,953	22,060	16,860	9,460
Montana	229,000	129,300	250,700	106,470
Nebraska	10,150	8,080	10,300	5,150
New Jersey	119,294	60,084	130,071	65,922
New York	121,170	72,113	230,839	130,251
Ohio	1,632,367	668,778	1,479,350	588,579
Pennsylvania	5,558,051	2,553,711	4,727,632	2,058,018
Rhode Island	433	583	279	312
South Carolina	100	100	350	100
South Dakota	14,510	6,304	56	28
Tennessee	313,721	136,903	173,740	82,573
Texas	96,884	55,551	133,651	64,072
Utah	160,432	103,465	197,647	133,685
Vermont	400	200	413	413
Virginia	499,108	199,989	273,826	117,882
Washington	101,161	60,703	117,041	65,085
West Virginia	708,572	243,135	711,883	244,535
Wisconsin	108,696	51,116	66,333	30,867
Wyoming	....	....	5,000	3,250
Total	12,029,719	5,423,732	10,657,038	4,702,768

From this table it will be seen that both the quantity and the value of the limestone used for furnace flux decreased in 1904, which was due to the shutting down of the iron furnaces for a time during the year.

The greatest decrease was in Pennsylvania. The total output decreased from 12,029,719 long tons, valued at $5,423,732, in 1903, to 10,657,038 long tons, valued at $4,702,768, in 1904, a loss in 1904 of 1,372,681 long tons in quantity and of $720,964 in value.

For the first time an attempt has been made to collect the figures showing the quantity of bulk lime burned in the United States during a calendar year, and the following table shows the results obtained:

Quantity and value of lime burned in the United States in 1904, by States.

[Short tons.]

State.	Quantity.	Value.	State.	Quantity.	Value.
Alabama	73,700	$236,805	Nevada	150	$2,700
Arizona	1,860	12,200	New Jersey	35,127	150,198
Arkansas	36,424	142,713	New Mexico	472	3,383
California	73,540	585,486	New York	101,810	396,281
Colorado	7,789	34,360	North Carolina	23,000	4,800
Connecticut	47,241	168,107	Ohio	279,491	989,693
Florida	9,072	55,085	Oklahoma	1,000	3,000
Georgia	20,804	58,772	Oregon	750	10,191
Idaho	4,983	40,142	Pennsylvania	567,300	1,537,673
Illinois	108,881	461,068	Rhode Island	4,553	31,871
Indiana	107,137	351,179	South Carolina	7,302	32,859
Indian Territory	30	194	South Dakota	3,700	23,960
Iowa	13,180	91,008	Tennessee	49,695	217,064
Kansas	1,837	10,770	Texas	45,000	134,316
Kentucky	9,830	25,880	Utah	19,000	85,500
Maine	186,881	799,517	Vermont	39,653	184,681
Maryland	116,934	309,079	Virginia	82,133	277,519
Massachusetts	68,993	322,141	Washington	41,626	216,454
Michigan	44,088	258,905	West Virginia	89,371	184,060
Minnesota	17,982	73,763	Wisconsin	189,981	670,391
Missouri	160,288	597,258	Wyoming	212	2,275
Montana	4,320	24,150	Total	2,697,120	9,817,451

Lime is sold by various units of measurement in the United States, the bushel, the barrel, and the ton being the principal measures. These, however, vary as to weight in the different States and in different parts of the same State, and even the same company sells by different measurements, according to demand. The average weight of the bushel is probably 80 pounds, and there are usually two and one-half bushels to a barrel, making a barrel of lime weigh 200 pounds. These weights, however, vary greatly, a barrel sometimes being over 300 pounds, and a bushel being 40 pounds. Some of the larger manufacturers are adopting the plan of quoting the value of lime by the hundredweight, and if this idea is carried out it will be easier to obtain more correct figures as to the quantity of lime burned in a year.

The value of the lime also varies considerably, according to the use to which it is put, and to the purity and richness of the lime itself.

In many of the States where limestone is found in abundance the farmers, in their leisure time, dig out a small quantity of stone, or collect it from their fields and burn one or two kilns of it for their own use as a fertilizer and sell it to the neighboring farmers at a small price, the cost to them being simply labor. This lime sells from 3 to 10 cents per bushel, and in the States where this is done to any considerable extent the price per ton is appreciably lowered, Pennsylvania, Maryland, and West Virginia being largely influenced by this custom.

The specially prepared hydrated lime, although more expensive than other lime, is now being largely used.

Pennsylvania is the largest producer, both in value and in quantity of production, being followed by Ohio, Maine, Wisconsin, and Missouri. The figures given in the tables are for bulk lime, exclusive of cooperage, as far as could be ascertained. When the value of the barrel is included the price is from 15 to 25 cents more per barrel.

CLAY-WORKING INDUSTRIES.

By Jefferson Middleton.

INTRODUCTION.

With the exception of the sections on clay production and on sand-lime brick, 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.

In the year 1904, while the value of all the clay products of the country was practically the same as in 1903 and the value of the brick and tile products showed a slight increase over the latter year, the fact remains that the industry on the whole was not in quite so flourishing a condition as in the year 1903.

The value of the clay products, as shown in the appended tables, decreased from $131,062,421 in 1903 to $131,023,248 in 1904, a decrease of $39,173, or 0.03 per cent. The increase in 1903 over 1902 was $8,892,890, or 7.28 per cent; in 1902 over 1901 it was $11,957,944, or 10.85 per cent.

The labor situation in the building trades, although not so bad as in 1903, was nevertheless somewhat disturbed by strikes. There were no strikes of any importance in the clay-working industries themselves, which was also true in 1903, but the consumption of clay products was affected by the strikes in the building trades. The flourishing condition of the industries during 1903 led all those engaged in them to look forward with anticipation for another season of great prosperity during 1904; these hopes were doomed to slight disappointment. The year 1905, however, bids fair to be one of even greater prosperity than 1903. The average prices obtained for brick, the only item on which an average price can be given, were for common exactly the same as in 1903, namely, $5.97 per thousand, though the value increased in some States quite remarkably, namely, in New York, the largest common-brick producing State in the Union, where it rose from $4.96 in 1903 to $5.80 in 1904. In Illinois, the next largest producer of common brick, it fell from $5.31 in 1903 to $5.17 in 1904; and in Pennsylvania it also declined from $6.66 in 1903 to $6.35 in 1904. The average value per thousand for the whole country for front brick rose from $12.48 in 1903 to $12.80 in 1904, and vitrified paving brick rose from $9.86 in 1903 to $10.28 in 1904.

The number of operating firms reporting remains about the same, increasing from 6,034 in 1903 to 6,069 in 1904. The average value of the output per plant was $21,589 in 1904, as compared with $21,721 in 1903. The average value of output per plant gradually increased from 1901 to 1903, which was the maximum and which was only slightly greater than that of 1904.

The number of operating firms reporting should not be taken to be the same as the number of plants, since many firms operated not only more than one plant in the same State, but also plants in different States, one operator reporting for 35 plants.

The pottery industry appeared to suffer more from the slight general depression in business than brick and tile, and showed quite a falling off from 1903. The latter year, at least in some portions of the country, began to give some evidence of a falling off in the trade. Whether this is due to the fact that a number of potters made a practice of disposing of their inferior goods to concerns offering pieces of pottery as premiums with various kinds of merchandise, which must in the end have a bad effect on American potting, or whether this industry simply felt to a greater extent than other branches of trade the slight halt in the general prosperity, is difficult to say.

There are some small plants which make no reports to this office, but the figures here reported are practically a census; for all plants not included in these figures represent considerably less than 1 per cent of the total.

For the first time, in response to the request of several leading fire-brick makers, an attempt was made to secure a statement of the quantity as well as of the value of fire-brick products. As is the case with nearly all new statistical inquiries, the statement of the quantity of fire brick in 1904 is not as satisfactory as it might have been, though it is believed that the figures given are fairly accurate. In reporting the quantity of fire brick, the number of tons of brick was asked for on the schedule, but a great many of the operators reported the number of brick; hence, in arriving at the figures given, the fire brick reported in tons was reduced to a 9-inch equivalent by allowing 3½ tons to the thousand bricks.

The sand-lime brick industry, in the manufacture of which the first plant was erected in this country in 1901, made slow progress until 1904. In 1903 there were only 16 plants that actually put a product on the market, which was valued at $155,400. In 1904 this number had increased to 57 plants, reporting a product valued at $463,128. That this method of manufacture of building material is a success and will be a permanent factor in the building industry is hardly to be doubted. It is also equally certain that it will never displace the time-honored burnt-clay brick. So far the evidence seems to establish the fact that it costs about as much to manufacture sand-lime bricks, even under favorable circumstances, as it does to make clay brick under similar circumstances. The final test, of course, will be one of durability of the product, and this can only be determined by time. Sand-lime brick will find its greatest use in regions where clay is scarce and sand is plentiful. As in the case of all new industries, many have embarked in it without proper preparation or experience, and failures are bound to come, but as experience is gained and improvements are made in the method of manipulating the material the obstacles to success will be overcome and the industry will undoubtedly prosper.

No report on the clay-working industry in 1904 would be complete without some mention of the magnificent display of clay products at the Louisiana Purchase Exposition held at St. Louis. The main exhibit of the clay-working industry was located in the mines building, where 20,000 square feet of floor space, in a prominent location, was assigned to this industry. Installed in this space was one of the most complete exhibits of clay products ever presented, and it attracted wide attention, as it was the first time that a comprehensive exhibit of this important industry has ever been attempted in this country, previous expositions having had small exhibits scattered throughout many buildings. The exhibits in this collection ranged from building brick, displayed in quite a number of pagodas and small buildings, through enameled brick and terra cotta, displayed at several handsome pagodas, to high-grade pottery and art faïence.

It is to be regretted that the potters of the United States did not take greater advantage of this opportunity to display their wares. The displays made by the few potters who took part were highly creditable, especially those showing sanitary wares.

It is to be regretted also that while this exhibit was complete in every particular and comprised at least three-fourths of all the clay exhibits of the Exposition, it did not contain all of the clay exhibits displayed at the Louisiana Purchase Exposition, as there were creditable displays by individual firms in two or three other buildings.

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.

BUILDING OPERATIONS.

The following table shows the number of building permits and the value of the buildings erected thereunder in the leading cities of the United States in 1903 and 1904. These figures are from official sources, having been furnished in each case by the city officials in charge of the building departments. They include not only the cost of new buildings, but also the cost of ordinary additions and repairs, it having been found impracticable to obtain statements covering simply the erection of new buildings. Nor is it possible to separate the brick and stone buildings from those built of wood and other materials, except in a few instances, but it is safe to assume that practically all the permits in the larger cities are for brick and stone buildings and that in the smaller cities nearly all the buildings erected are of wood.

Building operations in the leading cities of the United States in 1903 and 1904.

City.	1903.		1904.	
	Number of permits.	Cost of buildings.	Number of permits.	Cost of buildings.
Allegheny, Pa	734	$2,127,350	828	$2,219,096
Atlanta, Ga	3,441	3,161,445	3,542	4,213,446
Baltimore, Md	1,574	3,327,225	2,046	5,842,559
Boston, Mass	2,841	15,264,940	2,779	22,028,067
Brooklyn, N. Y.[a]	6,372	26,628,220	8,913	46,627,687
Buffalo, N. Y	2,011	6,263,402	2,677	6,638,319
Cambridge, Mass	519	1,290,694	473	1,964,020
Chicago, Ill	13,241	47,295,660	7,151	44,735,058
Cincinnati, Ohio	3,949	4,502,255	2,952	6,308,895
Cleveland, Ohio	3,226	6,259,931	3,911	6,562,590
Columbus, Ohio	1,529	3,909,189	1,652	3,785,335
Dayton, Ohio	1,200	2,522,280	1,283	2,380,000
Denver, Colo	1,946	4,725,401	2,081	4,091,668
Detroit, Mich	3,383	6,912,600	3,552	6,737,105
Fall River, Mass	385	1,023,900	314	769,450
Grand Rapids, Mich	1,114	1,178,581	1,328	1,635,624
Hartford, Conn	518	1,694,605	511	2,144,605
Indianapolis, Ind	2,532	3,026,292	3,238	4,072,136
Jersey City, N. J	1,103	3,011,951	1,118	3,523,780
Kansas City, Mo	3,644	7,705,375	4,351	8,816,757
Los Angeles, Cal	6,395	13,041,838	7,090	13,409,062
Louisville, Ky	1,749	2,428,332	1,904	2,313,596
Memphis, Tenn	2,342	2,383,764	2,813	2,264,880
Milwaukee, Wis	2,774	7,024,607	3,546	8,131,765
Minneapolis, Minn	7,882	7,720,804	4,466	6,701,965
Nashville, Tenn	6,049	1,420,912	5,849	1,450,422
Newark, N. J	1,695	5,473,779	2,182	6,304,947
New Haven, Conn	307	1,624,601	404	1,909,460
New Orleans, La	1,707	2,916,262	1,798	2,964,154
New York, N. Y.[b]	3,306	86,502,231	6,149	108,318,458
Omaha, Nebr	528	1,338,820	789	2,051,930
Philadelphia, Pa	9,257	33,487,211	8,398	28,967,760
Pittsburg, Pa	3,283	15,901,836	3,857	17,502,680
Providence, R. I	1,107	3,795,500	1,206	3,454,800
Reading, Pa	1,091	1,087,300	1,229	1,633,175
Richmond, Va	697	2,106,410	462	2,378,681
Rochester, N. Y	794	1,853,571	1,050	4,225,927
St. Joseph, Mo	753	933,045	985	688,027
St. Louis, Mo	4,802	14,544,430	5,960	14,075,794
St. Paul, Minn	1,470	3,645,775	2,675	7,033,110
San Francisco, Cal	2,136	17,264,245	5,060	17,494,948
Scranton, Pa	889	1,528,877	977	1,850,267
Seattle, Wash	6,914	6,495,781	7,436	7,801,120
Syracuse, N. Y	609	1,755,503	734	2,739,827
Washington, D. C	6,505	11,151,478	6,384	[c] 13,042,491
Worcester, Mass	697	2,335,961	627	1,871,376
Total	131,000	401,594,169	138,730	465,676,819

[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.
[c] The figures for Washington, D. C., include the value of District government building ($367,680), begun during the year 1904.

From this table will be seen that in the 46 cities the number of permits issued in 1904 was 138,730, as compared with 131,000 in 1903, a gain of 7,730 permits, or 5.90 per cent. The value of the buildings erected under these permits increased from $401,594,169 in 1903 to $465,676,819 in 1904, a gain of $64,082,650, or 15.96 per cent.

In some places the custom prevails of issuing one permit to cover more than one building, but in the majority of cases one permit covers only one operation. On this basis the average value of the buildings was $3,066 in 1903 and $3,357 in 1904. In Greater New York the number of permits increased from 9,678 in 1903 to 15,062 in 1904, an increase of 5,384, or 55.63 per cent. The value of the buildings erected under these permits increased from $113,130,451 in 1903 to $154,946,145 in 1904, an increase of $41,815,694, or 36.96 per cent. In New York City alone, including Manhattan and the Bronx, the permits increased from 3,306 in 1903 to 6,149 in 1904, which is nearly double, and the value of the buildings erected increased from $86,502,231 in 1903 to $108,318,458 in 1904, an increase of $21,816,227, or 25.22 per cent. In 1903, owing to the extensive strikes in the building trades in New York City, the building operations showed a falling off of $3,380,547; and while there were some strikes in the city during 1904, as shown by these figures, they were not of sufficient importance to retard the growth of the city. In Brooklyn the permits increased from 6,372 in 1903 to 8,913 in 1904, an increase of 2,541, or 39.88 per cent, and the value of the buildings erected increased from $26,628,220 in 1903 to $46,627,687 in 1904, an increase of $19,999,467, or 75.11 per cent. Chicago, next to Brooklyn, shows the largest value of buildings erected, those put up in 1904 being valued at $44,735,058, as compared with $47,295,660 in 1903. The decrease was partly caused by labor strikes in that strike-ridden city. The number of permits decreased from 13,241 in 1903 to 7,151 in 1904. Philadelphia, the next most important city in building operations, showed 8,398 permits issued in 1904, as compared with 9,257 in 1903, a loss of 859 permits, or 9.28 per cent, and the value of the buildings erected decreased from $33,487,211 in 1903 to $28,967,760, a decrease of $4,519,451, or 13.50 per cent. While the permits issued for new buildings in Boston, Mass., decreased from 2,841 in 1903 to 2,779 in 1904, the value of the buildings erected under these permits increased from $15,264,940 in 1903 to $22,028,067 in 1904. This would indicate probably that while the number of small buildings decreased, the larger buildings, such as business blocks and apartments, increased in number.

Pittsburg and San Francisco were next in order, though they were practically the same, as the former erected buildings valued at $17,502,680, while the latter's buildings were valued at $17,494,948, a difference of only $7,732. In 1903 San Francisco led Pittsburg by over one million in the value of the buildings erected. The number of permits in Pittsburg increased from 3,283 in 1903 to 3,857 in 1904, while the value of the buildings erected increased from $15,901,836 in 1903 to $17,502,680 in 1904, a gain of $1,600,844, or 10.07 per cent. In San Francisco the permits increased from 2,136 in 1903 to 5,060 in 1904, or more than double, while the value of the buildings increased from $17,264,245 in 1903 to $17,494,948 in 1904, a gain of $230,703, or 1.34 per cent. St. Louis held her own in the building industry for 1904. In 1903 there were 4,802 permits issued for the erection of buildings valued at $14,544,430; in 1904 the number of permits was 5,960 for buildings valued at $14,075,794. A falling off in the value of the buildings of St. Louis would naturally be looked for in 1904, in view of the fact that the number of buildings erected in 1903 would be abnormal in the anticipation of the Louisiana Purchase Exposition, which was held in that city in 1904. Baltimore, of the larger cities, as would be expected as a result of the fire in that city in February, showed the largest proportional gain in value of buildings erected in 1904. In 1903 the value of the buildings erected under the 1,574 permits issued in that city was $3,327,225, while in 1904 there were issued 2,046 permits, and the value of the improvements erected under them was $5,842,559, a gain in the latter year of $2,515,334, or 75.60 per cent, though Brooklyn was a close second, having increased, as stated above, $19,999,467, or 75.11 per cent, while Rochester showed the largest relative gain, or from $1,853,571 in 1903 to $4,225,927 in 1904, or 127.99 per cent. St. Paul also exceeded Baltimore in relative gain. The cities showing losses in 1904, besides those mentioned, were Columbus, Dayton, Denver, Detroit, Fall River, Louisville, Memphis, Minneapolis, Providence, St. Joseph, and Worcester. In the majority of the cases, however, the decreases were small. The average cost per operation under one permit in 1904 in Baltimore was $2,856, in 1903 $2,114, in 1902 $2,461; in Boston in 1904 it was $7,927, in 1903 $5,373, and in 1902 $9,457; in Brooklyn in 1904 it was $5,231, in 1903 $4,179, and in 1902 $9,232; in Chicago in 1904 it was $6,256, in 1903 $3,572, and in 1902 $7,910; in New York in 1904 it was $17,616, in 1903 $26,165, and in 1902 $31,242; and in Philadelphia in 1904 it was $3,449, in 1903 $3,618, and in 1902 $3,350.

PRODUCTION.

In the following tables will be found statements of the values of the clay products of the United States in 1903 and 1904:

Value of the products of clay in the United States in 1904, by States and Territories.

State.	Brick and tile.	Pottery.	Total.
Alabama	$1,257,015	$32,533	$1,289,548
Arizona	68,885		68,885
Arkansas	675,332	21,250	696,582
California	3,553,016	71,718	3,624,734
Colorado	1,153,921	35,370	1,189,291
Connecticut and Rhode Island	1,146,034	a 69,575	1,215,609
Delaware	158,970		158,970
District of Columbia	296,443	10,017	306,460
Florida	252,864		252,864
Georgia	1,898,879	22,057	1,920,936
Idaho	173,597		173,597
Illinois	9,947,751	829,696	10,777,447
Indiana	5,198,898	703,691	5,902,589
Indian Territory	268,926		268,926
Iowa	3,392,719	68,134	3,460,853
Kansas	1,843,630	(b)	1,843,630
Kentucky	1,929,664	157,613	2,087,277
Louisiana	1,009,274	2,204	1,011,478
Maine	558,361	(b)	558,361
Maryland	1,469,126	402,931	1,872,057
Massachusetts	1,440,743	288,315	1,729,058
Michigan	1,670,892	43,621	1,714,513
Minnesota	1,319,907	(b)	1,319,907
Mississippi	760,793	14,701	775,494
Missouri	5,410,686	70,818	5,481,504
Montana	279,431	(b)	279,431
Nebraska	1,067,387		1,067,387
Nevada	25,820		25,820
New Hampshire	479,985	(b)	479,985
New Jersey	7,354,294	5,949,753	13,304,047
New Mexico	108,764		108,764
New York	9,228,432	1,314,638	10,543,070
North Carolina	883,964	14,000	897,964
North Dakota	147,579		147,579
Ohio	13,978,485	11,669,298	25,647,783
Oklahoma	262,098		262,098
Oregon	446,340	(b)	446,340
Pennsylvania	15,421,981	1,399,882	16,821,863
South Carolina	716,458	15,575	732,033
South Dakota	63,203		63,203
Tennessee	1,284,201	151,584	1,435,785
Texas	1,429,596	106,501	1,536,097
Utah	419,726	(b)	419,726
Vermont	100,153	(b)	100,153
Virginia	1,708,728	27,664	1,736,392
Washington	1,178,919	22,000	1,200,919
West Virginia	1,009,344	1,065,205	2,074,549
Wisconsin	1,377,919	13,075	1,390,994
Wyoming	35,845		35,845
Other States		c 564,851	c 564,851
Total	105,864,978	25,158,270	131,023,248
Per cent of total	80.80	19.20	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 1903, by States and Territories.

State.	Brick and tile.	Pottery.	Total.
Alabama	$1,304,607	$23,320	$1,327,927
Arizona	109,755	....	109,755
Arkansas	578,346	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	(b)	1,527,008
Mississippi	662,737	14,295	677,032
Missouri	5,610,206	51,401	5,661,607
Montana	329,317	(b)	329,317
Nebraska	868,028	....	868,028
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] 468,711	[c] 468,711
Total	105,626,369	25,436,052	131,062,421
Per cent of total	80.59	19.41	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.

An inspection of these tables shows that the value of the clay products in the United States in 1904 was $131,023,248, as compared with $131,062,421 in 1903, a loss of $39,173, or 0.03 of 1 per cent.

Of the totals mentioned above, the materials which enter into structural and engineering arts—the brick and tile of this classification—composed $105,864,978, or 80.80 per cent, and pottery, or the finer grade of goods, composed $25,158,270, or 19.20 per cent. In 1903 these figures were, respectively, $105,626,369 and $25,436,052, or 80.59 and 19.41 per cent, which is a slight gain in the coarser products, though about these relative proportions have been maintained for quite a number of years.

The following table shows value of the clay products of the United States from 1899 to 1904:

Value of the products of clay in the United States, 1899–1904, by States and Territories.

State or Territory.	1899.	1900.	1901.	1902.	1903.	1904.
Alabama	$897,810	$712,727	$946,791	$1,016,364	$1,327,927	$1,289,548
Arizona	101,954	112,737	92,986	114,608	109,755	68,885
Arkansas	339,142	381,012	407,263	520,178	589,946	696,582
California	1,587,518	1,375,998	1,769,155	2,253,096	2,831,543	3,624,734
Colorado	1,071,388	1,200,519	1,594,867	2,200,983	2,068,310	1,189,291
Connecticut and Rhode Island	1,074,202	1,099,972	1,130,909	1,217,678	1,206,069	1,215,609
Delaware	168,485	156,274	131,164	144,934	203,908	158,970
District of Columbia	481,145	288,933	324,008	267,627	330,511	306,460
Florida	138,808	140,604	190,674	175,442	221,295	252,864
Georgia	1,263,995	1,193,218	1,545,083	1,508,669	1,731,022	1,920,936
Idaho	47,624	49,382	68,328	93,048	164,107	173,597
Illinois	7,259,825	7,708,859	9,642,490	9,881,840	11,190,797	10,777,447
Indiana	4,235,354	3,858,350	4,466,454	5,283,733	5,694,625	5,902,589
Indian Territory	35,075	30,233	117,224	167,674	166,022	268,926
Iowa	2,233,808	2,291,251	2,737,825	2,843,336	3,093,403	3,460,853
Kansas	839,767	1,016,750	981,020	1,221,588	1,487,004	1,843,630
Kentucky	1,358,428	1,481,324	1,514,543	1,873,043	2,190,959	2,087,277
Louisiana	554,729	507,694	615,703	642,424	813,387	1,011,478
Maine	662,685	724,934	734,678	656,648	677,182	558,361
Maryland	1,679,641	1,711,856	1,605,655	1,905,362	1,908,821	1,872,057
Massachusetts	2,181,710	1,833,101	1,870,837	2,375,667	2,108,685	1,729,058
Michigan	1,283,997	1,181,695	1,542,034	1,744,040	1,710,421	1,714,513
Minnesota	1,218,697	1,396,697	1,548,647	1,901,731	1,527,008	1,319,907
Mississippi	546,741	573,368	456,473	516,209	677,032	775,494
Missouri	3,666,616	3,736,567	4,474,553	5,166,414	5,661,607	5,481,504
Montana	314,340	350,489	539,221	278,727	329,317	279,431
Nebraska	843,315	683,958	806,473	757,668	868,028	1,067,387
Nevada	17,850	9,580	17,625	45,600	99,905	25,820
New Hampshire	570,287	485,013	765,964	887,124	568,621	479,985
New Jersey	10,787,273	10,928,423	11,681,878	12,613,263	13,416,939	13,304,047
New Mexico	108,090	41,898	81,345	68,879	142,039	108,764
New York	8,076,412	7,660,606	8,291,718	8,414,113	9,208,252	10,543,070
North Carolina	774,202	815,975	771,338	795,521	862,496	897,964
North Dakota	168,124	92,399	76,708	123,214	127,085	147,579
Ohio	16,500,625	18,304,628	21,574,985	24,249,748	25,208,128	25,647,783
Oklahoma	150,552	164,457	205,060	235,975	368,955	262,098
Oregon	327,374	281,385	[a] 263,891	[a] 318,604	425,544	416,340
Pennsylvania	14,103,245	13,391,748	15,321,742	17,833,425	18,847,324	16,821,863
South Carolina	605,329	711,336	575,218	613,511	657,195	732,033
South Dakota	46,500	43,440	59,365	63,425	68,825	63,203
Tennessee	948,853	915,578	893,967	913,125	1,186,516	1,435,785
Texas	1,221,119	1,171,017	1,723,375	1,693,814	1,472,580	1,536,097
Utah	216,449	234,221	291,189	359,005	440,384	419,726
Vermont	131,525	121,041	77,554	78,886	114,001	100,153
Virginia	1,093,784	1,305,195	1,439,347	1,577,833	1,673,346	1,736,392
Washington	591,277	625,459	944,798	905,231	928,265	1,200,919
West Virginia	1,451,539	2,016,765	1,946,480	2,518,544	2,558,560	2,074,549
Wisconsin	1,811,712	1,072,179	1,247,544	1,026,658	1,307,396	1,390,994
Wyoming	8,450	21,500	28,950	22,150	22,663	35,845
Other States	....	....	[b] 76,488	[c] 83,152	[d] 468,711	[d] 564,851
Total	95,797,370	96,212,345	110,211,587	122,169,531	131,062,421	131,023,248
Operating firms reporting	6,962	6,475	6,421	6,046	6,034	6,069

[a] Includes Hawaii.
[b] 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.
[c] 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.
[d] Includes pottery products which could not be separately classified without disclosing the operations of individual establishments.

This table shows the value of the clay products of the United States by States and Territories for six years, together with the total number of operating firms reporting in each year.

It will be seen that the total value of clay products has increased from $95,797,370 in 1899 gradually to $131,062,421 in 1903, an increase of $35,265,051, or 36.81 per cent. In 1904 there was a very slight decline, to $131,023,248. The number of operating firms reporting has decreased from 6,962 in 1899 to 6,069 in 1904, though this latter figure is a gain of 35 over the year 1903. This decrease is probably more apparent than real, since about the year 1899 the large combinations were effected which materially reduced the number of firms reporting but not the number of plants in operation.

An inspection of this table shows 26 States showing increases in 1904 over 1903, and 23 showing decreases. These figures, however, have been mostly small. The largest increase occurred in the State of New York, where it was $1,334,818. The increase in New York was due almost entirely to the increased output of common brick, while the decrease in Pennsylvania was largely due to the falling off in the fire-brick industry. Colorado also shows a considerable falling off, from $2,068,310 to $1,189,291, a decrease of $879,019, or 42.50 per cent. These decreases and increases do not seem to be confined to any one section of the country, as Illinois showed a decrease of $413,350, while the adjoining States of Indiana and Iowa showed increases, and Missouri showed a decrease.

In the following table will be found a comparison of several varieties of clay products made in 1903 and 1904, showing the actual gain or loss in each variety, together with the percentage of gain or loss.

Value of the products of clay in the United States in 1903 and 1904, with increase or decrease.

Product.	1903.	1904.	Decrease in 1904.	Percentage of decrease in 1904.
Common brick	$50,532,075	$51,768,558	[a] $1,236,483	[a] 2.45
Front brick	5,402,861	5,560,131	[a] 157,270	[a] 2.91
Vitrified paving brick	6,453,849	7,557,425	[a] 1,103,576	[a] 17.10
Fancy or ornamental brick	328,387	300,233	28,154	8.57
Enameled brick	569,689	545,397	24,292	4.26
Fire brick and stove lining	14,062,369	[b] 11,167,972	2,894,397	20.58
Draintile	4,639,214	5,348,555	[a] 709,341	[a] 15.29
Sewer pipe	8,525,369	9,187,423	[a] 662,054	[a] 7.77
Architectural terra cotta	4,672,028	4,107,473	564,555	12.08
Fireproofing, hollow building tile or blocks, and terra-cotta lumber	3,861,343	3,629,101	232,242	6.01
Tile (not drain)	3,505,329	3,023,428	481,901	13.75
Miscellaneous	3,073,856	3,669,282	[a] 595,426	[a] 19.37
Total brick and tile	105,626,369	105,864,978	[a] 238,609	[a] .23
Total pottery	25,436,052	25,158,270	277,782	1.09
Grand total	131,062,421	131,023,248	39,173	.03

[a] Increase. [b] Stove lining included in miscellaneous in 1904.

This table shows in a most striking manner the lines along which there has been the greatest and the least activity. It will be noticed that six varieties of brick and tile products showed an increase, and that six showed a decrease, those showing an increase being common brick, front brick, vitrified paving brick, draintile, sewer pipe, and miscellaneous products.

The largest increase shown in this table is that of the common building brick, which increased from $50,532,075 in 1903 to $51,768,558 in 1904, an increase of $1,236,483, or 2.45 per cent.

The vitrified paving brick industry showed the next largest increase—from $6,453,849 in 1903 to $7,557,425 in 1904, a gain of $1,103,576, or 17.10 per cent. This product shows the highest proportional gain of any of the clay products, and its use seems to be extending in a manner which should cause its manufacturers and the advocates of its use as a paving material much gratification.

Draintile was the variety which showed the next greatest increase—from $4,639,214 in 1903 to $5,348,555 in 1904, an increase of $709,341, or 15.29 per cent.

That sewer pipe continues to increase is indicated by the value of the product in 1904, when it was $9,187,423, as compared with $8,525,369 in 1903, a gain of $662,054, or 7.77 per cent.

The only other variety showing a definite gain was front brick, where the increase was 2.91 per cent, or from $5,402,861 in 1903 to $5,560,131 in 1904.

Although the products embraced under the miscellaneous column showed an increase of $595,426, or 19.37 per cent, the products included in this column are of such a varied character and so numerous that the increase can hardly be considered as having any important bearing. One item alone embraced in this column in 1904, which was not entered in 1903, that of stove lining, would account probably for nearly all of this increase.

Of the products which showed a decline the most striking is the fire-brick output, which decreased from $14,062,369 in 1903 to $11,167,972 in 1904, a falling off of $2,894,397, or 20.58 per cent. As almost the entire product of fire brick is used in the manufacture of iron and steel, the output naturally rises and falls with the output of those metals, and this decline therefore is largely an expression of the reduced output of pig iron in 1904, though the classification of stove lining in 1904 in the miscellaneous column is responsible for a portion of the decrease.

The products classed as tile (not drain), embracing roof, floor, wall, and mantel tile, show a considerable falling off—from $3,505,329 to $3,023,428, a loss of $481,901, or 13.75 per cent.

The architectural terra-cotta industry, which showed the largest proportional gain in value of any product in 1903 over 1902, that of $1,145,122, or 32.47 per cent, showed the greatest proportional decrease next to fire brick and tile (not drain) in 1904, when it decreased from

$4,672,028 to $4,107,473. The year 1903 seems to have been an abnormal year in this product, since 1904 shows a product considerably greater in value than that reported in 1902.

Fireproofing, which showed considerable gain in 1903 over 1902, in 1904 lost $232,242, or 6.01 per cent. The reason, however, is not obvious, since this material in the two large conflagrations of 1904, those of Baltimore, Md., and Rochester, N. Y., appear to have withstood the test in a most satisfactory manner. The same condition exists in this branch of the industry as in the architectural terra-cotta branch, namely, that 1903 seems to have been an abnormal year, inasmuch as while 1904 shows a decrease from 1903 it is $453,508, or 14.28 per cent greater than in 1902.

The other products showing a decrease were fancy or ornamental brick and enameled brick. This latter product is made principally in the Eastern States, in the neighborhood of New York City, and the slight decrease in 1904 may be accounted for by the fact that large engineering projects, which consumed considerable quantities of enameled brick in and around that city, were completed early in that year. Other projects of a similar nature, now either in hand or in contemplation, will undoubtedly largely increase the use of this material in the near future.

While the total brick and tile products, as stated before, show a small increase in 1904 over 1903, the pottery products show a slight decrease—from $25,436,052 in 1903 to $25,158,270 in 1904, a decrease of $277,782, or 1.09 per cent. Had the pottery products maintained even the small rate of increase shown by the brick and tile, the total for the pottery products would have been $25,494,555 and the total of all clay products would have been $131,359,533.

The following table shows the products of clay in the United States from 1894 to 1904, 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, 1894–1904, 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	$35,062,538	$5.70	(a)	(a)	....
1895	....	6,017,965	31,569,126	5.25	339,204	$4,399,367	$12.97
1896	5,293	5,703,279	29,664,043	5.20	270,335	3,390,941	12.54
1897	5,424	5,292,532	26,430,207	4.99	310,918	3,855,033	12.40
1898	5,971	5,867,415	30,980,704	5.28	295,833	3,572,385	12.08
1899	6,962	7,695,305	39,887,522	5.18	438,817	4,767,343	10.86
1900	6,475	7,140,622	38,621,514	5.41	344,516	3,864,670	11.09
1901	6,421	8,038,579	45,503,076	5.66	415,343	4,709,737	11.34
1902	6,046	8,475,067	48,885,869	5.77	458,391	5,318,008	11.60
1903	6,034	8,463,683	50,532,075	5.97	433,016	5,402,861	12.48
1904	6,069	8,665,171	51,768,558	5.97	434,351	5,560,131	12.80

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).	Draintile (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	328,387	569,689	d14,062,369	(d)	4,639,214
1904	735,489	7,557,425	10.28	300,233	545,397	11,167,972	(e)	5,348,555

Year.	Sewer pipe (value).	Architectural terra cotta (value).	Fireproofing (value).	Hollow building tile or blocks (value).	Tile, not drain (value).	Pottery (value).	Miscellaneous f (value).	Total value.
1894	$5,989,923	$1,476,185	$514,637	(g)	$1,688,724	(h)	$4,517,709	$64,655,385
1895	4,482,577	2,512,193	741,626	(g)	2,572,628	(h)	6,619,333	65,409,806
1896	4,588,503	2,359,983	1,706,504	(g)	1,618,127	$7,455,627	1,210,719	63,110,408
1897	4,069,534	1,841,422	1,979,259	(g)	1,476,638	10,309,209	1,413,595	62,359,991
1898	3,791,057	2,043,325	1,900,642	(g)	1,746,024	14,589,224	2,000,743	74,487,680
1899	4,560,334	2,027,532	1,665,066	(g)	1,276,300	17,250,250	6,065,928	95,797,370
1900	5,842,562	2,372,568	1,820,214	(g)	2,349,420	19,798,570	2,896,036	96,212,345
1901	6,736,969	3,367,982	1,860,269	(g)	2,867,659	22,463,860	2,945,268	110,211,587
1902	7,174,892	3,526,906	3,175,593	(g)	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	131,062,421
1904	9,187,423	4,107,473	2,502,603	1,126,498	3,023,428	25,158,270	3,669,282	131,023,248

a Common and pressed brick not separately classified in 1894.
b Enameled brick not separately classified prior to 1898.
c Stove lining not separately classified prior to 1899.
d Stove lining included in fire brick in 1903.
e Stove lining included in miscellaneous in 1904.
f Including pottery products in 1894 and 1895.
g Hollow building tile or blocks included in fireproofing prior to 1903.
h Pottery not separately classified in 1894 and 1895.

This table is interesting, inasmuch as it shows the clay-working industries for eleven years, the period covered by the statistical canvass of this office.

All of the products have advanced in total value of output from 1897 (which was the year showing the lowest total value since the beginning of the work) to 1904, with the exception of fancy or ornamental brick, which has shown a steady decline since the beginning of the canvass. This is caused no doubt largely by the fact that fancy-shaped brick are being displaced by architectural terra cotta. The total value of clay products in 1897 was $62,359,991, in 1904 it was $131,023,248, a gain of $68,663,257, or 110.11 per cent. The brick and tile products increased from $52,050,782 in 1897 to $105,864,978 in 1904, a gain of $53,814,196, or 103.39 per cent. The pottery industry showed, up to 1904, a much higher rate of gain, from $10,309,209 in 1897 to $25,158,270 in 1904, a gain of $14,849,061, or 144.04 per cent.

The number of common brick has risen from 5,292,532,000, valued at $26,430,207, in 1897 to 8,665,171,000, valued at $51,768,558, in 1904, an increase of 96 per cent in value. The average price per thousand has risen almost without a break from $4.99 in 1897 to $5.97 in 1903 and 1904.

Front brick showed the largest production in 1902, when it was 458,391,000. The greatest value was in 1904, when it was $5,560,131. The average value per thousand of front brick has varied since 1897 from $10.86 in 1899 to $12.80 in 1904.

Vitrified paving brick has shown steady gains from 1896 to 1904, being valued at $2,794,585 in the former year and $7,557,425 in the latter, while the price per thousand has ranged from $8.12 in 1894 to $10.28 in 1904. This value would be considerably greater except for the fact that vitrified paving blocks have been included in the miscellaneous column, since it might perhaps be misleading in averaging the value per thousand to include the paving block with the paving brick.

The enameled-brick industry, the figures for which were first collected in 1898, showed an almost steady rise until 1903, but in 1904 it showed a small decrease.

The fire-brick industry involves a large, important, and growing branch of the clay-working industry. The figures of this table show that it increased steadily from 1897 to 1903, but decreased considerably in 1904, as has been explained elsewhere.

The draintile product reached its maximum value in 1894, though it has steadily risen, except in 1900, from its minimum in 1896 to 1904, when the value was largest, next to 1894. This is a product which varies more or less with the weather conditions in the central West, the larger output being made in wet years, though undoubtedly the general advantage of drainage is making itself felt, and this industry will steadily advance irrespective of the weather conditions.

The sewer-pipe industry is another one that is increasing in a satisfactory manner, and one which indicates that the smaller municipalities, as well as the larger, are using this product where it would be impracticable to construct sewers of other material.

The architectural terra-cotta industry has advanced steadily since the year 1899, when it showed a small decrease, until 1904, when the product was slightly less than in 1903. This, however, is another branch of the clay-working industry which is destined to become very important, inasmuch as it takes the place of stone in large structures, and proved itself to be much more durable than stone when subjected to extremely high temperatures in the large fires in 1904.

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 1903 and 1904:

Rank of States, value of output, and percentage of total value of clay products in 1903 and 1904.

1904.

Rank.	State.	Number of operating firms reporting.	Value.	Per cent of total product.
1	Ohio	819	$25,647,783	19.57
2	Pennsylvania	529	16,821,863	12.84
3	New Jersey	161	13,304,047	10.15
4	Illinois	492	10,777,447	8.23
5	New York	240	10,543,070	8.05
6	Indiana	465	5,902,589	4.50
7	Missouri	232	5,481,504	4.18
8	California	121	3,624,734	2.77
9	Iowa	327	3,460,853	2.64
10	Kentucky	120	2,087,277	1.59
11	West Virginia	64	2,074,549	1.58
12	Georgia	103	1,920,936	1.47
13	Maryland	63	1,872,057	1.43
14	Kansas	69	1,843,630	1.41
15	Virginia	99	1,736,392	1.33
16	Massachusetts	87	1,729,058	1.32
17	Michigan	168	1,714,513	1.31
18	Texas	152	1,536,097	1.17
19	Tennessee	110	1,435,785	1.10
20	Wisconsin	159	1,390,994	1.06
21	Minnesota	114	1,319,907	1.01
22	Alabama	118	1,289,548	.98
23	Connecticut and Rhode Island	43	1,215,609	.93
24	Washington	26	1,200,919	.92
25	Colorado	90	1,189,291	.91
26	Nebraska	109	1,067,387	.81
27	Louisiana	74	1,011,478	.77
28	North Carolina	204	897,964	.69
29	Mississippi	92	775,494	.59
30	South Carolina	68	732,033	.56
31	Arkansas	69	696,582	.53
32	Maine	64	558,361	.43
33	New Hampshire	35	479,985	.37
34	Oregon	65	446,340	.34
35	Utah	51	419,726	.32
36	District of Columbia	15	306,460	.23
37	Montana	25	279,431	.21
38	Indian Territory	22	268,926	.21
39	Oklahoma	33	262,098	.20
40	Florida	17	252,864	.19
41	Idaho	43	173,597	.13
42	Delaware	24	158,970	.12
43	North Dakota	15	147,579	.11
44	New Mexico	15	108,764	.08
45	Vermont	12	100,153	.08
46	Arizona	18	68,885	.05
47	South Dakota	13	63,203	.05
48	Wyoming	10	35,845	.03
49	Nevada	5	25,820	.02
	Other States	....	[a]564,851	.43
	Total	6,069	131,023,248	100.00

[a] Includes pottery products which could not be separately classified without disclosing the operations of individual establishments.

Rank of State, value of output, and percentage of total value of clay products in 1903 and 1904—Continued.

1903.

Rank.	State.	Number of operating firms reporting.	Value.	Per cent of total product.
1	Ohio	815	$25,208,128	19.23
2	Pennsylvania	523	18,847,324	14.38
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	4.34
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	Maryland	59	1,908,821	1.46
15	Georgia	99	1,731,022	1.32
16	Michigan	178	1,710,421	1.31
17	Virginia	100	1,673,346	1.28
18	Minnesota	116	1,527,008	1.17
19	Kansas	56	1,487,004	1.13
20	Texas	168	1,472,580	1.12
21	Alabama	111	1,327,927	1.01
22	Wisconsin	158	1,307,396	.99
23	Connecticut and Rhode Island	41	1,206,069	.92
24	Tennessee	110	1,186,516	.90
25	Washington	67	928,265	.71
26	Nebraska	101	868,028	.66
27	North Carolina	195	862,496	.66
28	Louisiana	68	813,387	.62
29	Maine	64	677,182	.52
30	Mississippi	85	677,032	.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* 468,711	.35
	Total	6,034	131,062,421	100.00

a Includes pottery products which could not be separately classified 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 1904:

Rank of clay-producing States, in value of products of clay, 1894–1904.

State.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Alabama	31	28	26	24	26	23	26	23	23	21	22
Arizona	46	47	43	41	40	44	42	42	43	46	46
Arkansas	34	33	34	35	34	34	33	34	32	32	31
California	16	10	21	21	12	12	14	11	11	9	8
Colorado	27	22	29	25	25	21	16	14	12	13	25
Connecticut[a]	20	20	11	10	16	20	20	21	21	23	23
Delaware	43	41	41	39	39	38	39	40	41	40	42
District of Columbia	28	27	28	30	30	33	35	35	37	37	36
Florida	40	39	39	38	38	41	40	39	39	39	40
Georgia	18	15	15	14	18	15	17	16	19	15	12
Idaho	44	44	46	46	47	45	44	46	44	42	41
Illinois	2	3	4	5	4	5	4	4	4	4	4
Indiana	6	6	7	6	6	6	6	7	6	6	6
Indian Territory	(b)	(b)	(b)	47	45	47	47	41	40	41	38
Iowa	8	9	9	9	8	8	8	8	8	8	9
Kansas	33	32	32	32	27	25	22	22	20	19	14
Kentucky	19	19	18	17	15	14	12	18	15	11	10
Louisiana	24	25	25	26	24	31	31	30	30	28	27
Maine	17	21	13	18	21	27	25	29	29	29	32
Maryland	11	13	10	11	10	11	11	13	13	14	13
Massachusetts	9	8	8	8	9	9	10	10	10	12	16
Michigan	10	11	12	19	14	15	18	17	16	16	17
Minnesota	15	12	20	15	11	18	13	15	14	18	21
Mississippi	38	36	33	31	31	32	30	33	33	30	29
Missouri	7	7	6	7	7	7	7	6	7	7	7
Montana	37	35	31	33	32	36	34	32	36	38	37
Nebraska	23	34	36	28	23	24	28	26	28	26	26
Nevada	......	......	......	......	......	48	49	49	48	47	49
New Hampshire	26	23	22	23	28	30	32	28	26	33	33
New Jersey	5	5	5	3	3	3	3	3	3	3	3
New Mexico	(b)	(b)	(b)	43	44	43	46	43	46	43	44
New York	4	4	3	4	5	4	5	5	5	5	5
North Carolina	30	26	24	27	29	26	24	27	27	27	28
North Dakota	42	42	42	40	42	39	43	45	42	44	43
Ohio	1	1	1	1	1	1	1	1	1	1	1
Oklahoma	[b] 41	[b] 43	[b] 45	44	41	41	38	38	38	36	39
Oregon[c]	36	37	38	37	37	35	36	37	35	35	34
Pennsylvania	3	2	2	2	2	2	2	2	2	2	2
Rhode Island	29	29	30	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
South Carolina	32	30	27	29	35	28	27	31	31	31	30
South Dakota	45	45	44	45	46	46	45	47	47	48	47
Tennessee	22	24	23	22	22	22	23	25	24	24	19
Texas	13	14	14	12	19	17	19	12	17	20	18
Utah	35	40	37	36	36	37	37	36	34	34	35
Vermont	39	38	40	42	43	42	41	44	45	45	45
Virginia	14	18	17	16	17	19	15	19	18	17	15
Washington	25	31	35	34	33	29	29	24	25	25	24
West Virginia	21	17	16	13	13	13	9	9	9	10	11
Wisconsin	12	16	19	20	20	10	21	20	22	22	20
Wyoming	47	46	47	48	48	49	48	48	49	49	48

[a] Rhode Island is included with Connecticut in 1897, 1898, 1899, 1900, 1901, 1902, 1903, and 1904.
[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 in the Union produces clay products in greater or less quantity, the leading States are located in the northern portion of the country from the Atlantic Ocean to the Missouri River.

Ohio has been the leading State since the beginning of the canvass of the clay-working industry by the United States Geological Survey. In 1904 her products, reported by 819 operators, were valued at $25,647,783, or 19.57 per cent of the total. In 1903 this State reported products valued at $25,208,128 by 815 operators, and produced 19.23 per cent of the clay products of the entire country.

Pennsylvania still maintains the second position, with products valued at $16,821,863, or 12.84 per cent, in 1904, while in 1903 her products were valued at $18,847,324, or 14.38 per cent. In 1903 there were 523 operators reported; in 1904, 529.

New Jersey holds third rank, with products valued at $13,304,047 in 1904, as compared with $13,416,939 in 1903. The number of producers increased from 159 in 1903 to 161 in 1904.

Illinois, New York, Indiana, and Missouri maintain their respective positions of fourth, fifth, sixth, and seventh in both 1903 and 1904. In the latter year, however, California and Iowa exchanged places, the former going to eighth and the latter to ninth place.

Colorado showed the greatest change in relative rank, dropping from thirteenth in 1903 to twenty-fifth in 1904, with products valued, respectively, at $2,068,310 and $1,189,291. The decrease in this State is due largely to the falling off of its fire-clay products, because of the strike in the Cripple Creek region.

Other changes in relative ranks were Kansas, which went from nineteenth in 1903 to fourteenth in 1904; Minnesota, which fell from eighteenth in 1903 to twenty-first in 1904; Georgia, which rose from fifteenth in 1903 to twelfth in 1904; Indian Territory rose from forty-first in 1903 to thirty-eighth in 1904; Maine fell from twenty-ninth in 1903 to thirty-second in 1904; Massachusetts fell from twelfth in 1903 to sixteenth in 1904; Oklahoma fell from thirty-sixth in 1903 to thirty-ninth in 1904; Tennessee rose from twenty-fourth in 1903 to nineteenth in 1904.

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 1903 and 1904, the former year being presented for comparative purposes only:

Brick and tile products of the United States in 1904.

State.	Common brick.			Vitrified paving brick.		
	Quantity.	Value.	Average price per thousand.	Quantity.	Value.	Average price per thousand.
	Thousands.			*Thousands.*		
Alabama	150,170	$840,236	$5.60	(a)	(a)	$13.87
Arizona	9,507	68,885	7.25			
Arkansas	93,799	661,657	7.05			
California	256,898	1,843,936	7.18	(a)	(a)	18.08
Colorado	85,220	544,661	6.39	(a)	(a)	9.67
Connecticut and Rhode Island	186,908	1,039,204	5.56	(a)	(a)	14.00
Delaware	18,656	152,470	8.17			
District of Columbia	26,913	194,695	7.23			
Florida	44,484	248,579	5.59			
Georgia	269,815	1,374,318	5.09	(a)	(a)	12.00
Idaho	20,665	160,102	7.75	(a)	(a)	25.00
Illinois	999,310	5,167,165	5.17	121,073	$1,234,703	10.20
Indiana	283,707	1,677,714	5.91	51,859	513,209	9.90
Indian Territory	34,730	217,338	6.26	(a)	(a)	7.44
Iowa	207,041	1,440,758	6.96	19,231	199,528	10.38
Kansas	202,821	890,474	4.39	81,441	621,424	7.63
Kentucky	138,677	796,074	5.74	(a)	(a)	14.91
Louisiana	145,259	914,585	6.29	(a)	(a)	10.07
Maine	50,499	326,240	6.46	(a)	(a)	15.02
Maryland	160,279	1,048,850	6.54	(a)	(a)	10.08
Massachusetts	165,435	1,012,226	6.12	(a)	(a)	14.00
Michigan	205,196	1,116,714	5.44	(a)	(a)	13.28
Minnesota	164,154	970,247	5.91	(a)	(a)	10.00
Mississippi	110,183	710,878	6.45			
Missouri	271,370	1,690,460	6.23	47,235	480,671	10.17
Montana	18,176	145,642	8.01	(a)	(a)	16.00
Nebraska	133,074	904,750	6.80	5,531	45,063	8.15
Nevada	2,800	25,100	8.96			
New Hampshire	70,290	446,603	6.35			
New Jersey	319,975	1,842,075	5.76	4,953	66,813	13.49
New Mexico	11,694	79,927	6.83	(a)	(a)	10.00
New York	1,169,233	6,783,528	5.80	14,490	189,281	13.06
North Carolina	137,453	760,161	5.53	430	3,850	8.95
North Dakota	17,390	134,017	7.71			
Ohio	455,936	2,708,456	5.94	218,791	2,222,931	10.16
Oklahoma	33,813	233,280	6.90	(a)	(a)	7.00
Oregon	40,217	302,098	7.51			
Pennsylvania	856,963	5,439,116	6.35	71,522	766,638	10.72
South Carolina	131,198	665,688	5.07			
South Dakota	7,255	59,603	8.22			
Tennessee	158,223	946,131	5.98	(a)	(a)	11.80
Texas	197,033	1,157,130	5.87	(a)	(a)	8.81
Utah	40,128	255,358	6.36	(a)	(a)	9.00
Vermont	13,102	78,237	5.97			
Virginia	203,484	1,292,558	6.35	(a)	(a)	10.46
Washington	87,732	665,878	7.59	9,233	149,559	16.20
West Virginia	68,133	469,501	6.89	39,620	470,339	11.87
Wisconsin	186,292	1,230,620	6.61			
Wyoming	3,881	34,635	8.92			
Other States[b]				50,080	593,416	11.85
Total	8,665,171	51,768,558	5.97	735,489	7,557,425	10.28
Per cent of brick and tile products		48.90			7.14	
Per cent of total of clay products		39.51			5.77	

[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 1904—Continued.

State.	Front brick.			Fancy or ornamental brick (value).	Draintile (value).	Sewer pipe (value).	Architectural terra cotta (value).
	Quantity.	Value.	Average price per thousand.				
	Thousands.						
Alabama	430	$4,450	$10.35	(a)	(a)	(a)	....
Arizona	....	....	....	....	....	....	....
Arkansas	(a)	(a)	12.00	....	$1,675	....	....
California	11,722	291,813	24.89	$27,037	29,440	$568,626	$221,000
Colorado	18,827	214,498	11.39	3,248	4,704	(a)	....
Connecticut and Rhode Island	3,060	45,730	14.94	(a)	....	....	....
Delaware	(a)	(a)	14.71	....	(a)	....	....
District of Columbia	(a)	(a)	15.12	....	3,600	44,000	....
Florida	....	....	....	....	(a)	....	....
Georgia	3,924	42,064	10.72	(a)	8,099	165,068	(a)
Idaho	(a)	(a)	20.51	....	....	....	....
Illinois	21,299	251,762	11.82	11,733	1,002,463	550,344	(a)
Indiana	19,890	197,890	9.95	(a)	1,205,717	294,000	(a)
Indian Territory	1,888	22,017	11.66	....	....	....	....
Iowa	7,994	91,269	11.42	(a)	1,294,134	(a)	....
Kansas	16,959	129,576	7.64	(a)	10,883	(a)	....
Kentucky	2,178	20,571	9.44	....	26,564	(a)	....
Louisiana	5,180	54,534	10.53	....	(a)	....	....
Maine	733	6,950	9.48	....	2,944	(a)	....
Maryland	2,245	37,537	16.72	(a)	2,848	....	(a)
Massachusetts	(a)	(a)	21.67	(a)	....	....	(a)
Michigan	1,080	7,500	6.94	(a)	208.088	(a)	....
Minnesota	6,566	113,260	17.25	(a)	11,100	(a)	....
Mississippi	(a)	(a)	10.73	....	3,638	....	....
Missouri	25,599	322,445	12.60	32,967	80,479	1,176,679	(a)
Montana	136	2,598	19.10	(a)	(a)	(a)	....
Nebraska	7,107	106,572	15.00	(a)	....	....	....
Nevada	(a)	(a)	18.00	....	....	....	....
New Hampshire	(a)	(a)	10.80	....	....	....	....
New Jersey	47,058	687,469	14.61	(a)	24,842	23,299	1,412,023
New Mexico	(a)	(a)	12.22	....	....	....	....
New York	19,104	263,150	13.77	(a)	139,876	125,510	785,978
North Carolina	605	6,300	10.41	(a)	800	(a)	....
North Dakota	(a)	(a)	18.07	(a)	(a)	....	....
Ohio	65,645	755,870	11.51	64,514	1,143,957	3,495,917	....
Oklahoma	1,300	12,700	9.77	....	....	....	....
Oregon	1,350	21,750	16.11	(a)	21,553	(a)	....
Pennsylvania	75,407	962,765	12.77	23,317	8,646	834,646	349,317
South Carolina	910	13,200	14.51	(a)	(a)	....	....
South Dakota	....	....	....	....	....	....	....
Tennessee	8,332	80,906	9.71	29,316	12,350	(a)	....
Texas	5,645	58,734	10.40	2,544	(a)	(a)	....
Utah	8,940	92,902	10.39	(a)	(a)	(a)	....
Vermont	....	....	....	....	(a)	....	....
Virginia	21,077	344,891	16.36	28,576	5,673	....	....
Washington	3,999	81,142	20.29	(a)	8,812	215,282	(a)
West Virginia	388	5,380	13.87	....	1,398	(a)	(a)
Wisconsin	8,438	86,688	10.27	(a)	54,831	....	....
Wyoming	(a)	(a)	15.00	(a)	....	....	....
Other States [c]	9,336	123,248	13.20	76,981	29,441	1,694,052	1,339,155
Total	434,351	5,560,131	12.80	[b] 845,630	5,348,555	9,187,423	4,107,473
Per cent of brick and tile products	....	5.25	....	.80	5.05	8.68	3.88
Per cent of total of clay products	....	4.24	....	.65	4.08	7.01	3.14

[a] Included in Other States.

[b] Including enameled brick, valued at $545,397, made in the following States: California, Colorado, Illinois, Maryland, Missouri, New Jersey, Ohio, and Pennsylvania.

[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.

Brick and tile products of the United States in 1904—Continued.

State.	Fire-proofing (value).	Hollow building tile or blocks (value).	Tile, not drain (value).	Fire brick.			Miscellaneous (value).[a]	Total value.
				Quantity.	Value.	Average price per thousand.		
				Thousands.				
Alabama				8,596	$140,678	$16.37	$10,000	$1,257,015
Arizona								68,885
Arkansas				671	10,800	16.10		675,332
California	$51,125	$45,751	(b)	12,534	285,718	22.80	112,720	3,553,016
Colorado	(b)	(b)	(b)	4,606	110,053	23.89	45,000	1,153,921
Connecticut and Rhode Island			(b)	1,849	43,500	23.53		1,146,034
Delaware								158,970
District of Columbia	(b)						8,770	296,443
Florida				(b)	(b)	14.08		252,864
Georgia	(b)		(b)	3,460	28,100	8.12	9,069	1,898,879
Idaho				(b)	(b)	28.85		173,597
Illinois	324,264	6,460	194,471	16,916	217,008	12.83	41,572	9,947,751
Indiana	210,800	219,476	(b)	11,260	130,216	11.56	254,681	5,198,898
Indian Territory				254	4,475	17.62	23,756	268,926
Iowa		161,658	4,300	(b)	(b)	15.00	105,000	3,392,719
Kansas		(b)	(b)	385	4,375	11.36	45,581	1,843,630
Kentucky	(b)		(b)	40,948	680,084	16.61		1,929,664
Louisiana							31,400	1,009,274
Maine				(b)	(b)	15.04		558,361
Maryland			(b)	11,084	235,136	21.21	33,612	1,469,126
Massachusetts	(b)		72,000	(b)	(b)	20.83	195,773	1,440,743
Michigan		8,080		(b)	(b)	13.00		1,670,892
Minnesota	(b)	(b)						1,319,907
Mississippi		(b)						760,793
Missouri	(b)	(b)	(b)	48,607	925,520	19.04	342,327	5,410,686
Montana	(b)	(b)		1,797	102,611	57.10	1,480	279,431
Nebraska							3,502	1,067,387
Nevada								25,820
New Hampshire				(b)	(b)	27.24		479,985
New Jersey	947,253	264,393	548,097	39,752	908,882	22.86	416,745	7,354,294
New Mexico								108,764
New York	132,034	24,050	154,417	19,792	381,784	19.29	248,224	9,228,432
North Carolina				174	2,778	15.97		883,964
North Dakota	(b)			(b)	(b)	34.53		147,579
Ohio	476,276	312,549	1,005,611	79,939	1,186,966	14.85	581,545	13,978,485
Oklahoma				(b)	(b)	20.00	11,618	262,098
Oregon	(b)	(b)		49	1,599	32.63	300	446,340
Pennsylvania	139,036	54,154	215,107	275,592	5,477,475	19.88	1,042,282	15,421,981
South Carolina				3,377	36,960	10.94		716,458
South Dakota		(b)		(b)	(b)	20.00		63,203
Tennessee	(b)			4,390	53,185	12.12		1,284,201
Texas		(b)	(b)	1,982	30,208	15.24	66,593	1,429,596
Utah				(b)	(b)	13.60	6,565	419,726
Vermont							20,000	100,153
Virginia				1,371	24,306	17.73		1,708,728
Washington		(b)		711	22,445	31.57	9,767	1,178,919
West Virginia			(b)	896	11,814	13.19		1,009,344
Wisconsin		(b)					1,400	1,377,919
Wyoming								35,845
Other States[c]	221,815	29,927	829,425	6,768	111,296	16.41		(d)
Total	2,502,603	1,126,498	3,023,428	597,760	11,167,972	18.68	3,669,282	105,864,978
Per cent of brick and tile products	2.36	1.06	2.86		10.55		3.47	100.00
Per cent of total of clay products	1.91	.86	2.31		8.52		2.80	80.80

[a] Including adobes, aquarium ornaments, assayers' furnaces, boiler and locomotive tile and tank blocks, brick for chemical purposes, burnt clay ballast, carboy stoppers, chimney radial brick, pipe tops and thimbles, clay furnaces, retorts and settings, conduit work, crucibles, flue lining, foundation blocks, gas logs, glass-house supplies, grave and lot markers, hollow chimney blocks, insulators, muffles, oven tile, paving blocks, runner brick, sleeves and nozzles, rustic stumps, saggers, scorifiers, sewer brick, stone pumps, tunnel blocks, and wall coping.

[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 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	229,537	25.83
Colorado	132,733	893,566	6.73	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	236,833	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	8,204	111,403	13.58
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	47,795	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	433,016	5,402,861	12.48
Per cent of brick and tile products	....	47.84	....	....	5.12	....
Per cent of total of clay products	....	38.56	....	....	4.12	....

(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 paving brick. Quantity.	Vitrified paving brick. Value.	Vitrified paving brick. Average price per thousand.	Fancy or ornamental brick (value).	Fire brick (value).	Draintile (value).	Sewer pipe (value).
	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	$411,380
Colorado	2,477	$25,824	10.43	$4,618	631,074	3,000	(a)
Connecticut and Rhode Island	(a)	(a)	14.03	(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	532,858
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)	272,295	1,355	....
Massachusetts	....	....	....	(a)	200,225	....	....
Michigan	(a)	(a)	13.27	(a)	(a)	129,028	(a)
Minnesota	195	1,875	9.62	(a)	....	10,087	(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	(a)	....	....	....
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	1,561,936	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	13,509	(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	27,330	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	117,626	114,880	27,626	1,621,964
Total	654,499	6,453,849	9.86	[c] 898,076	14,062,369	4,639,214	8,525,369
Per cent of brick and tile products	....	6.11	....	.85	13.31	4.39	8.07
Per cent of total of clay products	....	4.92	....	.69	10.73	3.54	6.50

[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.

Brick and tile products of the United States in 1903—Continued.

State.	Architectural 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	1,198,477	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*)		19,138			1,662,414
Minnesota		(*b*)	50,500		160	1,527,008
Mississippi					200	662,737
Missouri	371,006	91,533	7,355	235,091	409,355	5,610,206
Montana		(*b*)	(*b*)	(*b*)		329,317
Nebraska					4,706	868,028
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	451,403	51,815	136,936		(*d*)
Total	4,672,028	2,708,143	1,153,200	3,505,329	3,073,856	105,626,369
Per cent of brick and tile products	4.42	2.57	1.09	3.32	2.91	100.00
Per cent of total of clay products	3.56	2.07	.88	2.67	2.35	80.59

[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, scorifiers, sectional sewer blocks, stone pumps, tunnel and well brick, and wall coping.

[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.

These tables show in detail by States and varieties the coarser products of clay in the United States in 1903 and 1904. It will be seen that the total brick and tile products increased from $105,626,369 in 1903 to $105,864,978 in 1904, a gain of $238,609, or 0.23 per cent. The corresponding increase in 1903 over 1902 was $7,584,291, or 7.74 per cent. The brick and tile products composed in 1903 80.59 per cent of all clay products, and in 1904 80.80 per cent. The common-brick industry, which is the most widespread, composes nearly half of the entire brick and tile products, or 48.90 per cent, and considerably more than a third of all clay products, namely, 39.51 per cent. The quantity of this product increased from 8,463,683,000 brick, valued at $50,532,075 in 1903 to 8,665.171,000, valued at $51,768,558 in 1904, a gain of 201,488,000 in product and of $1,236,483 in value over 1903.

New York continues to be the largest producer of common brick in the country, a large proportion of which, as shown elsewhere, is produced along the Hudson River. The product reported by this State for 1904 was 1,169,233,000, valued at $6,783,528; in 1903 New York's product of common brick was 1,068,464,000, a gain in 1904 of 100,769,000 brick. The value of these brick showed considerable advance, rising from $5,305,522 in 1903 to $6,783,528 in 1904, an increase of $1,478,006. The average price per thousand in this State rose from $4.96 in 1903 to $5.80 in 1904, which represents the largest increase in the average value per thousand of any State in the Union.

Illinois is the next largest producer of common brick, producing in 1904 999,310,000, valued at $5,167,165, or $5.17 per thousand, a falling off, however, from 1903, when the production was 1,015,541,000, valued at $5,388,589, or $5.31 per thousand.

Pennsylvania was third in rank in production of common brick, reporting 856,963,000 brick, valued at $5,439,116, or $6.35 per thousand in 1904, as against 927,212,000 brick, valued at $6,174,437, or $6.66 per thousand in 1903. This State is third in quantity reported and second in value, while Illinois ranks second in quantity and third in value. Ohio is fourth in rank of production of common brick, with 455,936,000 brick, valued at $2,708,456, or $5.94 per thousand, and New Jersey is fifth, with 319,975,000 brick, valued at $1,842,075, or $5.76 per thousand. In 1903 Ohio reported 497,071,000 brick, valued at $3,002,506, or $6.04 per thousand, and New Jersey reported 272,178,000, valued at $1,500,295, or $5.51 per thousand.

The next most important product in point of value is, as heretofore, the fire brick, which was valued at $11,167,972 in 1904, or 10.55 per cent of the brick and tile products, as against $14,062,369 in 1903, or 13.31 per cent of the brick and tile products. As pointed out elsewhere, there is a considerable decline in the value of this product in 1904 from 1903. From this column it will be seen that there were 597,760,000 fire brick reported, which would give an average value of $18.68 per thousand. The highest average value per thousand for any State was in Montana, where it was $57.10. As the quantity from this State is small, it is hardly fair to consider it in an effort to determine the highest price and the finest grade of fire brick made. The next highest State in average value was North Dakota, where the value was $34.53 per thousand, but the same objection to accepting this valuation obtains as in the case of Montana. In Pennsylvania, the great fire-brick producing State, the average value was $19.88 per thousand. One cause for the falling off in the value of the fire brick was the fact that in 1904 stove lining was added to this column, but even this would not account for more than about half the million dollars' decrease, while the decrease from 1903 was $2,894,397.

As in 1903, the sewer-pipe product was the next most important from the standpoint of value of products. In 1904 it was $9,187,423, or 8.68 per cent of the total brick and tile products and 7.01 per cent of all the clay products. Ohio is the largest producer of sewer pipe, with a value in 1904 of $3,495,917. In 1903 the sewer-pipe product was valued at $8,525,369, or 8.07 per cent of the total brick and tile products and 6.50 per cent of all clay products, and Ohio's product was valued at $3,295,635.

The product next in value was paving brick or vitrified brick, of which 735,489,000 were reported, valued at $7,557,425, an average value of $10.28 per thousand. This product composed 7.14 per cent of the total brick and tile products and 5.77 per cent of all the clay products. In 1903 this product was valued at $6,453,849, or 6.11 per cent of the brick and tile products and 4.92 per cent of all clay products. In that year the average price per thousand was $9.86.

Ohio was the leading producer of this variety of brick, reporting 218,791,000 brick in 1904, valued at $2,222,931, or $10.16 per thousand, as compared with Illinois, the next largest producer, which reported 121,073,000 brick, valued at $1,234,703, or $10.20 per thousand. Pennsylvania, Kansas, Indiana, and Missouri are the next largest producers in point of value of this product, in the order named.

RANK OF STATES.

The following tables show the rank of States in the output of brick and tile products as distinguished from pottery products and the percentage of the total made by each State and Territory in 1903 and 1904:

Rank of States, value of output, and percentage of total brick and tile products in 1903 and 1904.

1904.

Rank.	State.	Value.	Per cent of total product.
1	Pennsylvania	$15,421,981	14.57
2	Ohio	13,978,485	13.20
3	Illinois	9,947,751	9.40
4	New York	9,228,432	8.72
5	New Jersey	7,354,294	6.95
6	Missouri	5,410,686	5.11
7	Indiana	5,198,898	4.91
8	California	3,553,016	3.36
9	Iowa	3,392,719	3.21
10	Kentucky	1,929,664	1.82
11	Georgia	1,898,879	1.79
12	Kansas	1,843,630	1.74
13	Virginia	1,708,728	1.62
14	Michigan	1,670,892	1.58
15	Maryland	1,469,126	1.39
16	Massachusetts	1,440,743	1.36
17	Texas	1,429,596	1.35
18	Wisconsin	1,377,919	1.30
19	Minnesota	1,319,907	1.25
20	Tennessee	1,284,201	1.21
21	Alabama	1,257,015	1.19
22	Washington	1,178,919	1.11
23	Colorado	1,153,921	1.09
24	Connecticut and Rhode Island	1,146,034	1.08
25	Nebraska	1,067,387	1.01
26	West Virginia	1,009,344	.95
27	Louisiana	1,009,274	.95
28	North Carolina	883,964	.84
29	Mississippi	760,793	.72
30	South Carolina	716,458	.68
31	Arkansas	675,332	.64
32	Maine	558,361	.53
33	New Hampshire	479,985	.45
34	Oregon	446,340	.42
35	Utah	419,726	.40
36	District of Columbia	296,443	.28
37	Montana	279,431	.26
38	Indian Territory	268,926	.25
39	Oklahoma	262,098	.25
40	Florida	252,864	.24
41	Idaho	173,597	.16
42	Delaware	158,970	.15
43	North Dakota	147,579	.14
44	New Mexico	108,764	.10
45	Vermont	100,153	.09
46	Arizona	68,885	.07
47	South Dakota	63,203	.06
48	Wyoming	35,845	.03
49	Nevada	25,820	.02
	Total	105,864,978	100.00

Rank of States, value of output, and percentage of total brick and tile products in 1903 and 1904—Continued.

1903.

Rank.	State.	Value.	Per cent of total product.
1	Pennsylvania	$16,973,772	16.07
2	Ohio	14,120,041	13.37
3	Illinois	10,291,064	9.74
4	New York	7,934,174	7.51
5	New Jersey	7,101,713	6.72
6	Missouri	5,610,206	5.31
7	Indiana	5,113,656	4.84
8	Iowa	3,037,641	2.88
9	California	2,782,065	2.63
10	Kentucky	2,051,132	1.94
11	Colorado	2,011,411	1.90
12	Massachusetts	1,807,849	1.71
13	Georgia	1,708,880	1.62
14	Michigan	1,662,414	1.57
15	Virginia	1,650,660	1.56
16	Minnesota	1,527,008	1.44
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	Nebraska	868,028	.82
27	North Carolina	848,264	.80
28	Louisiana	813,387	.77
29	Maine	677,182	.64
30	Mississippi	662,737	.64
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	142,039	.13
44	North Dakota	127,085	.12
45	Vermont	114,001	.11
46	Arizona	109,755	.10
47	Nevada	99,905	.10
48	South Dakota	68,825	.07
49	Wyoming	22,663	.02
	Total	105,626,369	100.00

While Ohio is the leading State in the production of clay products, in brick and tile products she must take second place, Pennsylvania being first in 1903 and 1904, with products valued in 1904 at $15,421,981, or 14.57 per cent of the total brick and tile output, and in 1903 at $16,973,772, or 16.07 per cent of the total; this was a decrease in 1904 of $1,551,791, or 9.14 per cent. Ohio is second in both years. In 1904 this State produced wares valued at $13,978,485, or 13.20 per cent of the brick and tile products, and in 1903 at $14,120,041, or 13.37 per cent. As pointed out heretofore, Pennsylvania's high position in this branch of the industry is owing to her large output of building and fire brick, while Ohio's chief brick and tile products are common brick, vitrified paving brick, draintile, sewer pipe, fireproofing, and floor, wall, and art tiles. Ohio's leading position in the clay-working industry is due to her large output of pottery. The other leading States in brick and tile products generally maintain their relative positions, except Iowa and California, which exchanged places, and Colorado, which was eleventh in 1903 and twenty-third in 1904. Georgia, which was thirteenth in 1903, rose to eleventh in 1904; Kansas rose from seventeenth in 1903 to twelfth in 1904.

HUDSON RIVER REGION.

Probably the most interesting common brick producing region in this country is that along the Hudson River from Greater New York to Cohoes. Owing to the natural advantages of possessing clay highly adapted to the manufacture of common building brick and facilities for shipping by water to Greater New York—the greatest market for brick in the United States—this region has for many years been a very large producer of this variety of brick. The year 1904 was no exception, and the following tables show the operations in common brick manufactured in this region in 1903 and 1904. New York continues to be the largest producer of common brick, marketing in 1904 1,169,233,000 brick, as compared with 1,068,464,000 brick in 1903. Of this quantity 899,293,000, or 76.91 per cent of the total for the State, were produced in 1904 along the Hudson River, as compared with 798,254,000, or 74.71 per cent, in 1903. This entire region, embracing the counties of Albany, Columbia, Dutchess, Greene, Orange, Rensselaer, Rockland, Ulster, and Westchester, in the State of New York, and Bergen, in New Jersey, marketed in 1904 (practically all of the brick going to New York City), 958,219,000 brick, valued at $5,624,914, or $5.87 per thousand. This was a gain in quantity of 113,719,000 brick, or 13.47 per cent, and an increase in value of $1,651,598, or 41.57 per cent. The average price per thousand in the New York portion of this region is $5.88, as compared with $4.69 in 1903, a gain of $1.19 per thousand, which was probably the most remarkable gain in any locality of the United States. In the New Jersey portion of this region the value of the brick increased from $231,413 in 1903 to $337,776 in 1904, and the average price per thousand increased from $5 in 1903 to $5.73 in 1904. Of New Jersey's product of 319,975,000 common brick the portion of the State included in this table, Bergen County, produced 58,926,000, or 18.42 per cent of the total. The output of this entire region of common brick was exceeded only by the State of Illinois, where 999,310,000 common brick were reported, valued at $5,167,165. Pennsylvania, the next largest producer of common brick, fell over 100,000,000 brick below the output of this region. Ohio, the next largest producer of common brick, produced less than one-half of the output of this region. No other State produced one-third as much as this region, Indiana, the largest producer (excepting New Jersey, a portion of which is included in the region), furnishing 283,707,000 brick, or 29.61 per cent of the output of the region.

Ulster County was the largest producing county, reporting 226,452,000 brick, or 23.63 per cent of the total of the region, but the value of its product was exceeded by that of Rockland County, owing to the higher prices obtained in the latter county. It may be interesting to note that there were only eight States besides New York that produced more common brick than Ulster County in 1904. They were: California, 256,898,000 brick; Georgia, 269,815,000; Illinois, 999,310,000; Indiana, 283,707,000; Missouri, 271,370,000; New Jersey, 319,975,000; Ohio, 455,936,000; and Pennsylvania, 856,963,000. The largest producing county in 1903 also was Ulster, when a product of 190,981,000 common brick was reported, valued at $765,504, or $4.01 per thousand. In 1903 ten States besides New York showed a larger production than Ulster County.

The value of the common brick produced in 1904 in this region—$5,624,914—was greater than that of any State except New York, of which it is a part, Pennsylvania being the nearest, with common brick reported valued at $5,439,116. Pennsylvania was the only State that exceeded the value of the common-brick product of New York's portion of this region, and there were only eight States that exceeded in value Rockland County's output, and only ten States that exceeded in value Ulster County's product.

The average price per thousand in 1904 in this region ranged from $4.83 in Rensselaer County to $6.86 in Greene County. In 1903 the range was from $4.01 in Ulster County to $5.57 in Orange County.

Production of common brick in the Hudson River district, from Cohoes to New York City, in 1903 and 1904, by counties.

1904.

County.	Number of firms reporting.	Quantity.	Value.	Average price per thousand.
		Thousands.		
Albany	8	61,977	$328,500	$5.30
Columbia	5	70,200	466,000	6.64
Dutchess	16	150,997	850,030	5.63
Greene[a]	2	....	....	6.86
Orange	8	92,643	552,064	5.96
Rensselaer[a]	6	41,936	252,407	4.83
Rockland	31	216,563	1,382,316	6.38
Ulster	22	226,452	1,240,296	5.48
Westchester	7	38,525	215,525	5.59
Total for New York	105	899,293	5,287,138	5.88
Bergen County, N. J	11	58,926	337,776	5.73
Total	116	958,219	5,624,914	5.87

[a] In order to prevent disclosing the operations of individual establishments the product of Greene County is included with Rensselaer.

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

PRICES.

The following tables show the average prices per thousand of the various kinds of brick in 1903 and 1904, by States and Territories:

Average value per thousand of various kinds of bricks in 1904, by States and Territories.

COMMON BRICK.

Nevada	$8.96	Virginia	$6.35
Wyoming	8.92	Louisiana	6.29
South Dakota	8.22	Indian Territory	6.26
Delaware	8.17	Missouri	6.23
Montana	8.01	Massachusetts	6.12
Idaho	7.75	Rhode Island	6.00
North Dakota	7.71	Tennessee	5.98
Washington	7.59	Vermont	5.97
Oregon	7.51	Ohio	5.94
Arizona	7.25	Indiana	5.91
District of Columbia	7.23	Minnesota	5.91
California	7.18	Texas	5.87
Arkansas	7.05	New York	5.80
Iowa	6.96	New Jersey	5.76
Oklahoma	6.90	Kentucky	5.74
West Virginia	6.89	Alabama	5.60
New Mexico	6.83	Florida	5.59
Nebraska	6.80	North Carolina	5.53
Wisconsin	6.61	Connecticut	5.51
Maryland	6.54	Michigan	5.44
Maine	6.46	Illinois	5.17
Mississippi	6.45	Georgia	5.09
Colorado	6.39	South Carolina	5.07
Utah	6.36	Kansas	4.39
New Hampshire	6.35		
Pennsylvania	6.35	Average for United States	5.97

VITRIFIED PAVING BRICK.

Idaho	$25.00	Illinois	$10.20
California	18.08	Missouri	10.17
Washington	16.20	Ohio	10.16
Montana	16.00	Maryland	10.08
Maine	15.02	Louisiana	10.07
Kentucky	14.91	Minnesota	10.00
Massachusetts	14.00	New Mexico	10.00
Rhode Island	14.00	Indiana	9.90
Alabama	13.87	Colorado	9.67
New Jersey	13.49	Utah	9.00
Michigan	13.28	North Carolina	8.95
New York	13.06	Texas	8.81
Georgia	12.00	Nebraska	8.15
West Virginia	11.87	Kansas	7.63
Tennessee	11.80	Indian Territory	7.44
Pennsylvania	10.72	Oklahoma	7.00
Virginia	10.46		
Iowa	10.38	Average for United States	10.28

Average value per thousand of various kinds of bricks in 1904, by States and Territories—Continued.

FRONT BRICK.

California	$24.89	Arkansas	$12.00
Massachusetts	21.67	Illinois	11.82
Idaho	20.51	Indian Territory	11.66
Washington	20.29	Ohio	11.51
Montana	19.10	Iowa	11.42
North Dakota	18.07	Colorado	11.39
Nevada	18.00	New Hampshire	10.80
Minnesota	17.25	Mississippi	10.73
Maryland	16.72	Georgia	10.72
Virginia	16.36	Louisiana	10.53
Oregon	16.11	North Carolina	10.41
District of Columbia	15.12	Texas	10.40
Nebraska	15.00	Utah	10.39
Rhode Island	15.00	Alabama	10.35
Wyoming	15.00	Wisconsin	10.27
Delaware	14.71	Indiana	9.95
New Jersey	14.61	Oklahoma	9.77
South Carolina	14.51	Tennessee	9.71
West Virginia	13.87	Maine	9.48
New York	13.77	Kentucky	9.44
Pennsylvania	12.77	Kansas	7.64
Missouri	12.60	Michigan	6.94
New Mexico	12.22		
Connecticut	12.17	Average for United States	12.80

FIRE BRICK.

Montana	$57.10	Alabama	$16.37
North Dakota	34.53	Arkansas	16.10
Oregon	32.63	North Carolina	15.97
Washington	31.57	Texas	15.24
Idaho	28.85	Maine	15.04
New Hampshire	27.24	Iowa	15.00
Colorado	23.89	Ohio	14.85
Connecticut	23.53	Florida	14.08
New Jersey	22.86	Utah	13.60
California	22.80	West Virginia	13.19
Maryland	21.21	Michigan	13.00
Massachusetts	20.83	Illinois	12.83
Oklohoma	20.00	Tennessee	12.12
South Dakota	20.00	Indiana	11.56
Pennsylvania	19.88	Kansas	11.36
New York	19.29	South Carolina	10.94
Missouri	19.04	Georgia	8.12
Virginia	17.73		
Indian Territory	17.62	Average for United States	18.68
Kentucky	16.61		

Average value per thousand of various kinds of brick in 1903, by States and Territories.

COMMON BRICK.

Wyoming	$8.95	New Mexico	$6.35
Nevada	8.82	New Hampshire	6.30
Delaware	8.73	Missouri	6.28
South Dakota	8.17	Louisiana	6.20
North Dakota	7.86	Tennessee	6.08
Montana	7.78	Minnesota	6.07
Oregon	7.73	Ohio	6.04
Washington	7.65	Mississippi	6.03
District of Columbia	7.62	Texas	6.03
Idaho	7.45	Rhode Island	6.00
California	7.35	Florida	5.94
Oklahoma	7.27	Utah	5.92
Arizona	7.24	Alabama	5.84
Iowa	7.08	Michigan	5.80
Arkansas	7.04	Indiana	5.76
Colorado	6.73	Kentucky	5.59
Nebraska	6.66	Connecticut	5.57
Pennsylvania	6.66	New Jersey	5.51
Maine	6.65	North Carolina	5.33
Maryland	6.62	Illinois	5.31
Wisconsin	6.57	Georgia	5.06
Virginia	6.56	Kansas	4.97
West Virginia	6.55	New York	4.96
Indian Territory	6.54	South Carolina	4.91
Massachusetts	6.48		
Vermont	6.39	Average for United States	5.97

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 United States	9.86
Indiana	10.09		

Average value per thousand of various kinds of bricks in 1903, by States and Territories—Continued.

FRONT BRICK.

Oregon	$26.07	Ohio	$12.41
California	25.83	Texas	12.02
Montana	24.52	New Mexico	11.99
Connecticut	23.00	Mississippi	11.98
South Dakota	20.00	Minnesota	11.40
Massachusetts	19.98	Illinois	10.93
Washington	19.22	North Carolina	10.74
Nevada	18.53	Colorado	10.70
Delaware	18.07	Iowa	10.60
Virginia	16.08	Tennessee	10.49
New Hampshire	15.47	Arkansas	9.88
District of Columbia	15.24	Indiana	9.36
Rhode Island	15.00	South Carolina	9.33
Maryland	14.84	Wisconsin	9.25
North Dakota	13.73	Utah	9.17
Nebraska	13.58	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 United States	12.48

It will be seen from these tables that the average price per thousand of common brick ranged in 1904 from $8.96 in Nevada to $4.39 in Kansas, the average price for the whole country being $5.97. The low average in Kansas is probably due to the strong competition in the manufacture of brick in the gas belt and the low cost of burning brick by the use of natural gas. In 1903 the price ranged from $8.95 in Wyoming to $4.91 in South Carolina. The average price for the whole country for common brick in the two years was exactly the same, namely, $5.97. In 1903 Wyoming was second, with an average of $8.92; South Dakota third, with $8.22; and Delaware fourth, with $8.17. These, however, are all small producing States. In New York, which was next to lowest in 1903, with an average value of $4.96 per thousand, the price increased in 1904 to $5.80. In the large producing States, with the exception of New York, the changes in the average value per thousand have not been great since 1903. In 1904 the average price in Vermont was the same as the average for the whole country, namely, $5.97. In 1903 Rhode Island and Florida were equally near the general average of $5.97, the former being $6 per thousand and the latter $5.94. On the whole it may be stated that the highest prices for brick prevail in the far western States, as might be expected.

In 1904 the average price of vitrified paving brick ranged from $25 in Idaho to $7 per thousand in Oklahoma, the average for the country being $10.28. In Illinois the average price most nearly approached that of the entire country, it being $10.20 in that State. In Ohio, the largest producer of this variety of brick, the average price was $10.16, and in Kansas it was only $7.63, which was practically the lowest, owing to the fact that Indian Territory and Oklahoma are small producers of this variety of brick. In 1903 the average price of vitrified brick ranged from $20 in Idaho to $7.96 in Kansas, an average for the entire country of $9.86.

Front brick ranged in value in 1904 from $24.89 in California to $6.94 in Michigan, with an average of $12.80 for the country. The general average was most nearly approached in Pennsylvania, where it was $12.77. In 1903 the value ranged from $26.07 in Oregon to $7.83 in Kentucky, with an average for the whole country of $12.48, the average of West Virginia being the same as that of the entire country.

The average price for fire brick, the figures for which were collected for the first time in 1904, ranged from $57.10 in Montana to $8.12 in Georgia, with an average for the United States of $18.68. The extremely high prices are in States where the product is small, and hence have no very great effect on the general average. In the larger producing States, such as Pennsylvania, Ohio, Missouri, New Jersey, and Kentucky, where the prices ranged from $22.86 to $14.85, the State with the average nearest to that of the general average was Missouri, where it was $19.04.

POTTERY.

INTRODUCTION.

The year 1904, as shown by the figures returned to this office, was not as satisfactory to the pottery trade, judging by the value of the output, as the year 1903, the production showing a slight falling off from that year. This decline, which occurred almost exclusively in the manufacture of C. C. and white granite wares, is probably due to the reaction caused by the pottery boom of 1902 and 1903, and was foreshadowed in the 1903 report.

The production of these wares fell from $12,563,512 in 1903 to $11,791,821 in 1904, a loss of $771,691, or 6.14 per cent. The total number of firms reporting these wares also decreased in 1904 as compared with 1903.

The total value of the product fell from $25,436,052 in 1903 to $25,158,270 in 1904, a decrease of $277,782, or 1.09 per cent. This is the first year since the Geological Survey began a canvass of the industry that the product has shown a decline in the value, having increased from $7,455,627 in 1896 to the maximum in 1903. That the decrease was not caused by an abnormal increase in the imports of pottery is shown by the fact that the imports in 1903 were, china, plain and decorated, $11,131,811, and in 1904, $11,188,290, or practically the same. In 1903 the imports of these wares showed a large increase over 1902, when they were $9,511,608, showing an increase in the white ware alone in 1903 of $1,620,203, or 17.03 per cent; whereas in 1904 this increase was only $56,479, or 0.51 per cent. The increase in the value of all pottery imports in 1903 over 1902 was $1,657,167, or 17.32 per cent, while in 1904 the increase over 1903 was only $42,540, or 0.38 per cent. This would lead to the conclusion that this industry simply suffered from the slight decline in the general prosperity of the country during 1904.

In 1903 the gain in the pottery industry over 1902 was $1,308,599, or 5.42 per cent, the value of the product in 1902 being $24,127,453.

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 1903 and 1904:

Value of pottery products, by varieties of products in 1904, 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	$2,330	$28,691				
Arkansas	(a)	20,250				
California	37,675	7,330				
Colorado	3,300	(b)	(b)			
Connecticut	17,600	(b)				
District of Columbia	10,017					
Georgia	7,258	14,799				
Illinois	24,250	777,696	(c)			
Indiana	4,300	61,090			(b)	
Iowa	9,800	56,250				
Kansas		(b)				
Kentucky	20,171	137,442				
Louisiana	2,204					
Maine		(b)				
Maryland	13,440		(c)		$150,500	
Massachusetts	133,594	21,386		(b)		
Michigan	40,621					
Minnesota	(b)	(b)				
Mississippi	(b)	14,594				
Missouri	7,749	61,578				
Montana	(b)					
New Hampshire						
New Jersey	18,000	52,419		$325,959	259,623	$357,894
New York	33,650	41,131	(b)		(b)	(b)
North Carolina	638	13,362				
Ohio	136,794	1,013,839	$178,817	422,630	2,653,374	294,260
Oregon	(b)	(b)				
Pennsylvania	127,250	371,096	(b)	(b)	178,809	(b)
South Carolina	2,487	13,088				
Tennessee	2,450	113,534				
Texas	6,611	99,860				
Utah	(b)					
Virginia	(b)	(b)				
Washington	2,600	19,400				
West Virginia		18,923		(b)	300,000	
Wisconsin	11,325					
Other States (d)	20,562	401,817	57,525	105,800	338,301	244,456
Total plain	696,676	3,359,575	236,342	854,389	3,880,607	896,610

DECORATED.

State.	Red earthenware.	Stoneware.	Yellow and Rockingham ware.	C. C. ware.	White granite, semiporcelain ware, and semivitreous porcelain ware.	China.
Maryland					$232,000	
Massachusetts	(e)					
New Jersey	(b)				1,024,576	(b)
New York						(f)
Ohio	$25,840	$50,500	(b)	(g)	4,534,924	$220,252
Pennsylvania	5,875		(b)		529,000	(b)
West Virginia				(g)	552,935	
Other States (d)	28,234	950	$54,477		82,075	466,651
Total decorated	59,949	51,450	54,477		6,955,510	686,903
Grand total	756,625	3,411,025	290,819	$854,389	10,836,117	1,583,513
Per cent of total clay products	.58	2.60	.22	.65	8.27	1.21
Per cent of pottery products	3.01	13.56	1.16	3.40	43.07	6.29

[a] Plain red earthenware for Arkansas included in Arkansas miscellaneous.
[b] Included in Other States.
[c] Plain yellow and Rockingham ware for Illinois and Maryland are included in the miscellaneous column of each of these States.
[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 red earthenware for Massachusetts included in Massachusetts miscellaneous.
[f] Decorated china for New York included in New York miscellaneous.
[g] Decorated C. C. ware for Ohio and West Virginia are included in the miscellaneous column of each of these States.

Value of pottery products, by varieties of products in 1904, by States and Territories—Continued.

PLAIN.

State.	Bone china, delft, and belleek ware.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.
Alabama				$1,512	$32,533
Arkansas				1,000	21,250
California		(b)	(b)	14,000	71,718
Colorado				745	24,870
Connecticut			(b)	13,248	69,575
District of Columbia					10,017
Georgia					22,057
Illinois				27,750	829,696
Indiana		$425,000	(b)		703,691
Iowa				2,084	68,134
Kansas					(c)
Kentucky					157,613
Louisiana					2,204
Maine					(c)
Maryland				6,991	170,931
Massachusetts			(b)	4,382	226,362
Michigan				3,000	43,621
Minnesota					(c)
Mississippi					14,701
Missouri			(d)	1,491	70,818
Montana					(c)
New Hampshire				(b)	(c)
New Jersey	$111,000	2,853,621	$302,293	103,428	4,384,237
New York		(b)	438,792	62,276	1,041,528
North Carolina					14,000
Ohio		(e)	557,027	1,034,531	6,291,272
Oregon					(c)
Pennsylvania		(b)		3,500	855,536
South Carolina					15,575
Tennessee				35,600	151,584
Texas				30	106,501
Utah					(c)
Virginia			(b)	9,584	27,664
Washington					22,000
West Virginia		(b)		3,101	492,024
Wisconsin					11,325
Other States		281,004	133,340	15,000	f 416,492
Total plain	111,000	3,559,625	1,431,452	1,343,253	16,369,529

DECORATED.

State.	Bone china, delft, and belleek ware.	Sanitary ware.	Porcelain electrical supplies.	Miscellaneous.[a]	Total.
Maryland					$232,000
Massachusetts				$61,953	61,953
New Jersey	$51,500	(b)		5,560	1,565,516
New York				273,110	273,110
Ohio				493,333	5,378,026
Pennsylvania					544,346
West Virginia				20,246	573,181
Other States		$25,750		49,000	g 160,609
Total decorated	51,500	25,750		903,202	8,788,741
Grand total	162,500	3,585,375	$1,431,452	2,246,455	25,158,270
Per cent of total clay products	.12	2.74	1.09	1.72	19.20
Per cent of pottery products	.64	14.25	5.69	8.93	100.00

[a] Including art and chemical pottery, bread toasters, faïence, Flemish ware, Hampshire pottery, porcelain door and shutter knobs, shuttle eyes and thread guides, filters and filter tubes, porcelain hardware trimmings, porcelain-lined cooking ware, pins, stilts and spurs for potters' use, souvenirs, Teco art pottery, tobacco pipes, toy marbles and banks, turpentine cups, and washboards.

[b] Included in Other States.

[c] Included in *f* ($416,492).

[d] Porcelain electrical supplies for Missouri included in Missouri miscellaneous.

[e] Plain sanitary ware for Ohio included in Ohio miscellaneous.

[f] Made up of State totals of Kansas, Maine, Minnesota, Montana, New Hampshire, Oregon, and Utah.

[g] Made up of State totals of California, Colorado, Connecticut, Illinois, Indiana, Louisiana, Minnesota, Missouri, New Hampshire, Oregon, Vermont, and Wisconsin.

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	13,550	(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	(a)	(a)				
Mississippi	580	13,715				
Missouri	6,697	43,304				
Montana	(a)					
New Jersey	14,500	50,404	(b)	$409,029	386,934	$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	133,391	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]	31,008	433,393	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)	1,188,958	$133,791
Ohio	$28,970	$141,551		$342,836	4,005,011	98,760
Pennsylvania	5,150	(a)			749,796	(a)
West Virginia					750,878	
Other States[d]	32,295	6,472		52,500	130,908	303,799
Total decorated	66,415	148,023		395,336	7,114,551	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	8.50	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					139,827
Louisiana					(d)
Maine					(d)
Maryland				6,827	182,755
Massachusetts				75,923	214,305
Michigan				6,000	48,007
Minnesota					(d)
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 442,466
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	19.41
Per cent of pottery products	.28	13.22	5.76	7.87	100.00

[a] Including art and chemical pottery, Easter ware faïence, Flemish ware, Gueby 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 ($442,466).

[e] Porcelain electrical supplies for Missouri included in Missouri miscellaneous.

[f] Made up of State totals of Louisiana, Maine, Minnesota, 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.

These tables show that the total value of the pottery products was $25,436,052 in 1903 and $25,158,270 in 1904, a decrease of $277,782, or 1.09 per cent. In 1903 the gain over 1902 was $1,308,599, or 5.42 per cent, and in 1902 the gain over 1901 was $1,663,593, or 7.41 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, although the more common ware, such as earthenware and stoneware, has a more general geographical distribution.

The following tables give the value of pottery products as plain and decorated ware made in each State in 1903 and 1904, by States and Territories:

Value of pottery products of the United States in 1904, by States and Territories.

State.	Plain.	Decorated.	Total.
Alabama	$32,533		$32,533
Arkansas	21,250		21,250
California	71,718	(a)	71,718
Colorado	24,870	$10,500	35,370
Connecticut	69,575	(a)	69,575
District of Columbia	10,017		10,017
Georgia	22,057		22,057
Illinois	829,696	(a)	829,696
Indiana	703,691	(a)	703,691
Iowa	68,134		68,134
Kansas	(a)		(a)
Kentucky	157,613		157,613
Louisiana	2,204	(a)	2,204
Maine	(a)		(a)
Maryland	170,931	232,000	402,931
Massachusetts	226,362	61,953	288,315
Michigan	43,621		43,621
Minnesota	(a)	(a)	(a)
Mississippi	14,701		14,701
Missouri	70,818	(a)	70,818
Montana	(a)		(a)
New Hampshire	(a)	(a)	(a)
New Jersey	4,384,237	1,565,516	5,949,753
New York	1,041,528	273,110	1,314,638
North Carolina	14,000		14,000
Ohio	6,291,272	5,378,026	11,669,298
Oregon	(a)	(a)	(a)
Pennsylvania	855,536	544,346	1,399,882
South Carolina	15,575		15,575
Tennessee	151,584		151,584
Texas	106,501		106,501
Utah	(a)		(a)
Vermont		(a)	(a)
Virginia	27,664		27,664
Washington	22,000		22,000
West Virginia	492,024	573,181	1,065,205
Wisconsin	11,325	1,750	13,075
Other States [b]	416,492	148,359	564,851
Total	16,369,529	8,788,741	25,158,270
Per cent of total	65.07	34.93	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 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	(a)	(a)	(a)
Mississippi	14,295		14,295
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]	442,466	26,245	468,711
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.

It will be seen from these tables that the plain ware constitued 65.07 per cent of the products in 1904 and 62.84 per cent in 1903, and that the decorated ware constituted 34.93 per cent and 37.16 per cent in 1904 and 1903, respectively. These proportions have continued to be about the same for several years—that is, two-thirds of the ware produced is plain and one-third is decorated. In 1904 nineteen States report decorated ware, but in only eight was the product valued at over $10,000. Plain ware was reported to the value of $15,983,740 in 1903 and of $16,369,529 in 1904, a gain of $385,789, or 2.41 per cent, while the decorated ware showed a loss from $9,452,312 in 1903 to $8,788,741 in 1904, a decrease of $663,571, or 7.02 per cent. This decrease was a good deal greater than the decrease of the entire pottery industry.

Ohio continued to be the leading producer of decorated ware, $5,378,026 worth of this product coming in 1904 from this State, or 61.19 per cent of the total decorated output.

New Jersey was second, with decorated ware valued at $1,565,516, or 17.81 per cent of the output. West Virginia was third, reporting ware valued at $573,181, or 6.52 per cent. Pennsylvania was fourth, reporting ware valued at $544,346, or 6.20 per cent. These four States produced in 1904 decorated ware to the value of $8,061,069, or 91.72 per cent of this variety. The same States in 1903 produced decorated ware to the value of $8,552,625, or 90.48 per cent of the total. In 1903 Pennsylvania's decorated ware was valued at $802,041, and West Virginia's product was valued at $750,878. Pennsylvania's pottery product has decreased very considerably, as shown elsewhere, owing to the cessation of operations at several of the new plants recently established in that State.

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 disclosure of individual returns.

The following tables show 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 1904 and 1903:

Value of pottery products in the United States in 1903 and 1904, by varieties.

1904.

Variety.	Plain.	Decorated.	Total.	Number of producers.	Percentage of pottery produced.
Red earthenware	$697,676	$98,602	$796,278	199	3.16
Stoneware	3,359,575	51,450	3,411,025	261	13.56
Yellow and Rockingham ware	265,833	54,477	320,310	16	1.27
C. C. ware	854,389	101,315	955,704	12	3.80
White granite, semiporcelain, and semivitreous porcelain ware	3,880,607	6,955,510	10,836,117	70	43.07
China	896,610	927,013	1,823,623	13	7.25
Bone china, delft, and belleek ware	111,000	51,500	162,500	5	.65
Sanitary ware	3,734,625	25,750	3,760,375	31	14.95
Porcelain electrical supplies	1,432,943	....	1,432,943	33	5.69
Miscellaneous[a]	1,136,271	523,124	1,659,395	67	6.60
Total	16,369,529	8,788,741	25,158,270	....	100.00
Per cent of total	65.07	34.93	100.00	....	....

[a] Including art and chemical pottery; bread toasters; faience; Flemish ware; Hampshire pottery; porcelain door and shutter knobs; shuttle eyes and thread guides; filters and filter tubes; porcelain hardware trimmings; porcelain-lined cooking ware; pins, stilts, and spurs for potters' use; souvenirs; Teco art pottery; tobacco pipes; toy marbles and banks; turpentine cups, and washboards.

Value of pottery products in the United States in 1903 and 1904, by varieties—Continued.

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.

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 former tables it was necessary to combine some of the products in order to prevent disclosing individual returns. The figures given in these tables, 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 1904 was $25,158,270, divided as follows: Plain, $16,369,529, or 65.07 per cent of the total, and decorated, $8,788,741, or 34.93 per cent of the total. In 1903 these figures were $25,436,052 for the total value, of which $15,983,740, or 62.84 per cent, was plain, and $9,452,312, or 37.16 per cent, was decorated. As in former years, white granite is the leading variety of pottery, as reported to this office, its value in 1904 being $10,836,117, or 43.07 per cent of the total, with $3,880,607, or 35.81 per cent, reported as plain, and $6,955,510, or 64.19 per cent, reported as decorated. In 1903 this variety was valued at $11,140,916, or 43.80 per cent of the total, with $4,026,365, or 36.14 per cent, plain ware, and $7,114,551, or 63.86 per cent, decorated.

The product of next importance, as far as value is concerned, is sanitary ware, which was valued in 1904 at $3,760,375, or 14.95 per cent of the total. Practically all of this was, as might be expected, plain. In 1903 the sanitary ware reported was valued at $3,517,263, or 13.83 per cent of the total—a slight increase in 1904. As in previous years stoneware was the product of next importance from a monetary standpoint, this product being valued at $3,411,025, or 13.56 per cent of the total, of which $3,359,575 was reported plain, and only $51,450 decorated. The production of china ware, which is always of more or less general interest, continues to gain slightly, this variety of ware being valued in 1904 at $1,823,623, or 7.25 per cent of the total, as compared with $1,686,502, or 6.63 per cent of the total, in 1903. The proportion of plain and decorated in this variety of ware continues to be about even, plain being valued in 1904 at $896,610, or 49.17 per cent, and decorated at $927,013, or 50.83 per cent; while in 1903 the plain was valued at $850,152, or 50.41 per cent, and the decorated at $836,350, or 49.59 per cent of the total. From this it will be seen that the decorated made a slight gain in 1904. Another feature of interest in connection with this variety of product is that the number of producers reporting it has gradually increased, being 10 in 1902, 11 in 1903, and 13 in 1904. White ware, including that made for sanitary purposes, which is almost entirely composed of a white body, and porcelain electrical supplies, aggregated $18,971,262, or 75.41 per cent of the whole, as compared with $19,338,857, or 76.03 per cent of the whole, in 1903. Of the total for white ware in 1904 $10,910,174, or 57.51 per cent, is plain, and $8,061,088, or 42.49 per cent, is decorated.

Exclusive of sanitary ware and porcelain electrical supplies, which were practically all plain, the total value of the white ware products was $13,777,944, of which $5,742,606, or 41.68 per cent, was plain and $8,035,338, or 58.32 per cent, was decorated. These figures are also interesting from the fact that they include the products generally understood by the public, and by 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, except 1901 and 1903, has seemed to be on the decline, showed a small falling off in 1904 also, the figures being $320,310, as compared with $333,521 in 1903. In 1903 the product increased $83,251, or 33.26 per cent, over 1902, when its value was reported as $250,270. This product is mostly all plain, $265,833, or 82.99 per cent, being thus reported. Stoneware, which is made in more States than any other pottery product except red earthenware, showed a slight increase from $3,333,142 in 1903, or 13.10 per cent of the total, to $3,411,025, or 13.56 per cent, in 1904, a gain of $77,883, or 2.34 per cent.

Red earthenware, which consists almost exclusively of flower pots and can be made from almost any good brick clay, showed an increase from $760,075 in 1903 to $796,278 in 1904, a gain of $36,203, or 4.76 per cent. This product was 2.99 per cent of the total in 1903, and 3.16 per cent in 1904.

The number of firms reporting the different varieties of these wares is interesting. They range from 261 reporting stoneware to 5 reporting bone china, delft, and belleek ware. The same number of firms—namely, 199—reported earthenware in both years. In 1904 four more firms reported stoneware than in 1903. The producers of yellow and Rockingham ware fell off from 17 to 16, and the C. C. ware producers decreased from 20 in 1903 to 12 in 1904. This probably indicates that the potters are improving the grade of their wares. White granite, semiporcelain, etc., are reported by the same number in each year—namely, 70. China makers have increased from 11 in 1903 to 13 in 1904, and the producers of the still higher grades of ware, bone china, delft, and belleek increased from 4 to 5. Sanitary-ware producers have increased from 30 to 31, and porcelain electrical-supply makers have increased from 31 to 33. There is no footing to this column for the reason that a footing 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, the value of the product in each State, the percentage of the total product made by each State in 1903 and 1904, and the number of firms reporting in each State:

Rank of States, value of output, and percentage of total of pottery products in 1904.

Rank.	State.	Number of firms reporting.	Value.	Per cent of total product.
1	Ohio	133	$11,669,298	46.38
2	New Jersey	50	5,949,753	23.65
3	Pennsylvania	49	1,399,882	5.56
4	New York	22	1,314,638	5.23
5	West Virginia	9	1,065,205	4.23
6	Illinois	26	829,696	3.30
7	Indiana	16	703,691	2.80
8	Maryland	10	402,931	1.60
9	Massachusetts	17	288,315	1.15
10	Kentucky	13	157,613	.63
11	Tennessee	12	151,584	.60
12	Texas	19	106,501	.42
13	California	18	71,718	.28
14	Missouri	16	70,818	.28
15	Connecticut	4	69,575	.28
16	Iowa	7	68,134	.27
17	Michigan	4	43,621	.17
18	Colorado	6	35,370	.14
19	Alabama	26	32,533	.13
20	Virginia	3	27,664	.11
21	Georgia	22	22,057	.09
22	Washington	4	22,000	.09
23	Arkansas	3	21,250	.08
24	South Carolina	8	15,575	.06
25	Mississippi	8	14,701	.06
26	North Carolina	28	14,000	.06
27	Wisconsin	4	13,075	.05
28	District of Columbia	3	10,017	.04
29	Louisiana	4	2,204	.01
	Kansas, Maine, Minnesota, Montana, New Hampshire, Oregon, Utah, and Vermont	12	417,382	1.66
	Total	556	[a] 25,158,270	[b] 100.00

[a] Includes $147,469 for decorated pottery, which could not be separately classified without disclosing the operations of individual establishments.
[b] Includes 0.59 per cent for unclassified decorated pottery, valued at $147,469.

Rank of States, value of output, and percentage of 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	Massachusetts	17	300,836	1.18
10	Kentucky	11	139,827	.55
11	Tennessee	13	114,174	.45
12	Connecticut	5	112,450	.44
13	Texas	19	97,666	.38
14	Colorado	6	56,869	.22
15	Iowa	7	55,762	.22
16	Missouri	17	51,401	.20
17	California	14	49,478	.20
18	Michigan	4	48,007	.19
19	Kansas	3	23,529	.09
20	Alabama	23	23,320	.09
21	Virginia	3	22,686	.09
22	Georgia	20	22,142	.09
23	Washington	3	16,100	.06
24	Mississippi	8	14,295	.06
25	North Carolina	25	14,232	.06
26	Wisconsin	4	13,586	.05
27	Arkansas	3	11,600	.05
28	District of Columbia	3	10,854	.04
29	South Carolina	8	9,827	.04
30	Utah	4	5,300	.02
	Louisiana, Maine, Minnesota, Montana, New Hampshire, Oregon, and Vermont	11	444,331	1.74
	Total	546	[a] 25,436,052	[b] 100.00

[a] Includes $24,380 for decorated pottery, which could not be separately classified without disclosing the operations of individual establishments.
[b] Includes 0.10 per cent for unclassified decorated pottery, valued at $24,380.

Ohio continues to be the leading pottery-producing State in the Union, reporting a product in 1904 valued at $11,669,298, or 46.38 per cent of the total, compared with $11,088,087, or 43.59 per cent of the total, in 1903, a gain in 1904 of $581,211, or 5.24 per cent. This product was reported by 133 operators in 1904 and by 129 in 1903. New Jersey was second in both years, reporting products valued at $5,949,753, or 23.65 per cent of the total, in 1904, and $6,315,226, or 24.83 per cent of the total, in 1903, a decrease in 1904 of $365,473, or 5.79 per cent. Reports were received from 50 operators in New Jersey in 1904 and from 51 in 1903. Pennsylvania was third in both years, her product showing a considerable decline in 1904 as compared with 1903, the figures being $1,873,552, or 7.37 per cent of the total, in 1903, and $1,399,882, or 5.56 per cent of the total, in 1904, a loss of $473,670, or 25.28 per cent. The firms reporting from Pennsylvania decreased from 52 in 1903 to 49 in 1904. New York showed an increase of $40,560, or 3.18 per cent, rising from $1,274,078, reported by 22 operators, in 1903, to $1,314,638, reported by 22 operators, in 1904. West Virginia showed a falling off from $1,248,500 in 1903 to $1,065,205 in 1904, a loss of $183,295, or 14.68 per cent. There was no change in the relative rank of the first eleven States. Illinois, the sixth, showed a decrease in 1904, whereas Indiana, the seventh, showed an increase of from $580,969 in 1903 to $703,691 in 1904. Maryland, the eighth, fell off from $473,255 in 1903 to $402,931 in 1904. The first five States, all large producers of white ware, reported ware valued at $21,799,443, or 85.71 per cent of the total, in 1903. In 1904 these States produced ware valued at $21,398,776, or 85.05 per cent of the total. The first nine States, each of which produced more than 1 per cent of the total pottery output, produced wares valued at $24,054,236, or 94.57 per cent of the total, reported by 332 operators, in 1903, and in 1904 wares valued at $23,623,409, or 93.90 per cent of the total. The changes of relative rank in the rest of the States is unimportant.

In the following table will be found a statement showing the number of potteries reporting during the years from 1901 to 1904, with the number of idle and operating plants:

Number of operating and idle potteries in the United States reporting in 1901, 1902, 1903, and 1904.

State.	1901.			1902.			1903.			1904.		
	Operating.	Idle.	Total.	Operating.	Idle.	Total.	Operating.	Idle.	Total.	Operating.	Idle.	Total.
Alabama	22	2	24	24	4	28	23	1	24	26	3	29
Arkansas	5	0	5	3	0	3	3	0	3	3	0	3
California	10	2	12	12	0	12	14	3	17	18	1	19
Colorado	4	1	5	6	1	7	6	1	7	6	2	8
Connecticut	5	0	5	5	0	5	5	0	5	4	0	4
District of Columbia	3	0	3	3	0	3	3	0	3	3	0	3
Florida	1	0	1	1	0	1	0	1	1	0	1	1
Georgia	18	3	21	18	3	21	20	2	22	22	0	22
Idaho	0	1	1	0	1	1	.....	.....	.....	.....	.....	.....
Illinois	24	3	27	25	2	27	27	3	30	26	3	29
Indiana	14	1	15	13	1	14	16	0	16	16	0	16
Iowa	8	3	11	9	1	10	7	1	8	7	1	8
Kansas	1	2	3	2	1	3	3	0	3	2	1	3
Kentucky	11	1	12	11	0	11	11	0	11	13	0	13
Louisiana	3	1	4	2	0	2	3	0	3	4	0	4
Maine	2	0	2	1	1	2	1	0	1	1	0	1
Maryland	10	0	10	12	1	13	10	1	11	10	1	11
Massachusetts	18	0	18	18	0	18	17	0	17	17	0	17
Michigan	5	0	5	4	0	4	4	0	4	4	0	4
Minnesota	2	0	2	2	0	2	2	0	2	2	0	2
Mississippi	6	0	6	8	0	8	8	1	9	8	0	8
Missouri	16	1	17	15	0	15	17	1	18	16	2	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	50	2	52	51	3	54	51	0	51	50	5	55
New York	25	1	26	21	4	25	22	2	24	22	4	26
North Carolina	33	4	37	26	3	29	25	2	27	28	3	31
Ohio	109	8	117	113	7	120	129	6	135	133	8	141
Oregon	2	0	2	2	0	2	2	0	2	2	0	2
Pennsylvania	48	3	51	47	5	52	52	2	54	49	5	54
South Carolina	12	0	12	10	2	12	8	2	10	8	0	8
Tennessee	16	1	17	10	1	11	13	2	15	12	1	13
Texas	26	3	29	20	3	23	19	0	19	19	6	25
Utah	2	0	2	3	0	3	4	0	4	2	1	[illegible]
Vermont	.....	.....	.....	.....	.....	.....	1	0	1	1	0	1
Virginia	4	3	7	3	3	6	3	3	6	3	2	5
Washington	5	0	5	4	1	5	3	0	3	4	0	4
West Virginia	9	0	9	8	0	8	8	0	8	9	3	12
Wisconsin	4	0	4	4	0	4	4	0	4	4	1	5
Total	535	47	582	518	49	567	546	35	581	556	55	611

The total number of operating firms reporting increased from 546 in 1903 to 556 in 1904, an increase of 10. The increases are as follows: Alabama, 3; California, 4; Georgia, 2; Kentucky, 2; Louisiana, 1; North Carolina, 3; Ohio, 4; Washington, 1; West Virginia, 1; and the decreases occurred in the following States: Connecticut, 1; Illinois, 1; Kansas, 1; Missouri, 1; New Jersey, 1; Pennsylvania, 3; Tennessee, 1; Utah, 2. These decreases, with the exception of Illinois, New Jersey, and Pennsylvania, are in comparatively unimportant pottery-producing States. The idle plants increased from 35 in 1903 to 55 in 1904, which may, in part, account for the decrease in value of the pottery products. The total number of plants reporting increased from 581 in 1903 to 611 in 1904.

TRENTON, N. J., AND EAST LIVERPOOL, OHIO.

As the Hudson River region is the most interesting center of production of common brick in the United States, so East Liverpool, Ohio, and Trenton, N. J., are the points which naturally occur to one as the places where the pottery of the United States is manufactured, though Trenton is practically the only place in New Jersey where pottery is made, while East Liverpool, Ohio, has to share its glory with quite a number of smaller pottery centers in other parts of the State.

The following tables show the value of the pottery products of Trenton and East Liverpool in 1903 and 1904:

Value of pottery products of Trenton, N. J., and East Liverpool, Ohio, in 1904, by varieties

Variety.	Trenton.	East Liverpool.	Total.
Yellow and Rockingham ware	....	$77,230	$77,230
C. C. ware	$325,959	583,937	909,896
White granite, semiporcelain, and semivitreous porcelain ware	1,284,199	3,919,371	5,203,570
China	816,374	(a)	816,374
Bone china, delft, and belleek ware	162,500	....	162,500
Sanitary ware	2,591,702	....	2,591,702
Porcelain electrical supplies	276,714	371,802	648,516
Miscellaneous b	83,270	451,650	534,920
Total	5,540,718	5,403,990	10,944,708
Per cent of total pottery product	22.02	21.48	43.50

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 door and shutter knobs, etc.

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	$544,864	$998,893
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.

From these tables it will be seen that the remarkable equality in the value of the output of these two places continues, Trenton producing wares valued at $5,540,718, or 22.02 per cent of the total in 1904, and

East Liverpool, wares valued at $5,403,990, or 21.48 per cent, the combined production being valued at $10,944,708, or 43.50 per cent of the pottery products of the entire country. In 1903 Trenton and East Liverpool produced ware valued at $5,813,432, or 22.86 per cent of the pottery products of the country, and $5,395,443, or 21.21 per cent, respectively. This is a difference in 1904 of $136,728, or 2.53 per cent, in favor of Trenton. The difference between the values of the products in the two States was somewhat greater in 1903, when it was $417,989, or 7.75 per cent, in favor of Trenton. This is the greatest difference that has existed since the comparisons have been made by this office. In 1902 the difference was $101,198, or 1.81 per cent, and in 1901 it was only $13,036. It will thus be seen that while Trenton has reported products of greater value each year, the difference has gradually increased until 1903, but that in 1904 it fell back slightly again. While the value of Trenton's product decreased from $5,813,432 in 1903 to $5,540,718 in 1904, or 4.69 per cent, East Liverpool's product increased slightly, from $5,395,443 in 1903 to $5,403,990 in 1904. In 1903 these conditions were reversed, Trenton increasing her output 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. Of the total pottery products of New Jersey in 1904, valued at $5,949,753, Trenton produced $5,540,718, or 93.13 per cent, while of Ohio's product, valued at $11,669,298, East Liverpool produced $5,403,990, or 46.31 per cent. In 1903 these places produced 92.05 and 48.66 per cent, respectively. As will be seen from these tables, Trenton made in 1904 no yellow or Rockingham ware, and East Liverpool made no bone china, delft, belleek, or sanitary ware. Trenton's leading products are sanitary ware and white granite ware, and East Liverpool's are white granite, semiporcelain, and semivitreous porcelain ware.

CONSUMPTION.

The imports of pottery into the United States in 1904 were valued at $11,270,241, and the production at $25,158,270, a total of $36,428,511. After deducting the exports, domestic $791,739 and foreign $32,640, there appears a net consumption of $35,604,132, of which the domestic production was 70.66 per cent in 1904. The domestic production was 70.56 per cent of the consumption in 1903, 72.91 per cent 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 domestic production as compared with consumption from 1898 to 1902 was checked in 1903 by a fall from 72.91 to 70.56 per cent—in other words, domestic production did not increase as rapidly as importation.

IMPORTS AND EXPORTS.

The following table gives the imports of clay products from 1867 to 1904, inclusive. It will be seen that the imports of 1904 are the largest ever recorded, having increased from $11,456,290 in 1903 to $11,488,411 in 1904, an increase of $32,121, or 0.28 per cent. The increase of 1903 over 1902 was $1,650,019, or 16.83 per cent.

Value of earthenware, china, brick, and tile imported and entered for consumption in the United States, 1867–1904.

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, tile, etc.	Total.
June 30—						
1867	$48,618	$418,493	$439,824	$4,280,924	....	$5,187,859
1868	47,208	309,960	403,555	3,244,958	....	4,005,681
1869	34,260	400,894	555,425	3,468,970	....	4,459,549
1870	47,457	420,442	530,805	3,461,524	....	4,460,228
1871	96,695	391,374	571,032	3,573,254	....	4,632,355
1872	127,346	470,749	814,134	3,896,664	....	5,308,893
1873	115,253	479,617	867,206	4,289,868	....	5,751,944
1874	70,544	397,730	676,656	3,686,794	....	4,831,724
1875	68,501	436,883	654,965	3,280,867	....	4,441,216
1876	36,744	409,539	718,156	2,948,517	....	4,112,956
1877	30,403	326,956	668,514	2,746,186	....	3,772,059
1878	18,714	389,133	657,485	3,031,393	....	4,096,725
1879	19,868	296,591	813,850	2,914,567	....	4,044,876
1880	31,504	334,371	1,188,847	3,945,666	....	5,500,388
1881	27,586	321,259	1,621,112	4,413,369	....	6,383,326
1882	36,023	316,811	2,075,708	4,438,237	....	6,866,779
1883	43,864	368,943	2,587,545	5,685,709	....	8,686,061
1884	50,172	982,499	2,664,231	(a)	$666,595	4,363,497
1885	44,701	823,334	2,834,718	....	963,422	4,666,175
December 31—						
1886	37,820	865,446	3,350,145	....	951,293	5,204,704
1887	43,079	967,694	3,888,509	....	1,008,360	5,907,642
1888	55,558	1,054,854	4,207,598	....	886,314	6,204,324
1889	48,824	1,148,026	4,580,321	....	788,391	6,565,562
1890	56,730	974,627	3,562,851	....	563,568	5,157,776
1891	99,983	1,921,643	6,288,088	....	353,736	8,663,450
1892	63,003	2,022,814	6,555,172	....	380,520	9,021,509
1893	57,017	1,732,481	6,248,255	....	338,143	8,375,896
1894	47,114	1,550,950	5,392,648	....	189,631	7,180,343
1895	61,424	2,117,425	8,055,473	....	211,473	10,445,795
1896	41,585	1,511,542	7,729,942	....	247,455	9,530,524
1897	b 32,227	1,406,019	7,057,261	....	146,668	8,642,175
1898	b 54,672	1,002,729	5,905,209	....	117,324	7,079,934
1899	b 40,164	1,125,892	6,740,884	....	134,691	8,041,631
1900	b 65,214	1,059,152	7,617,756	....	169,951	8,912,073
1901	b 51,551	1,094,078	8,385,514	....	150,268	9,681,411
1902	b 58,926	1,016,010	8,495,598	....	235,737	9,806,271
1903	b 95,890	1,234,223	9,897,588	....	228,589	11,456,290
1904	b 81,951	1,329,146	9,859,144	....	218,170	11,488,411

a Not separately classified after 1883. b Including Rockingham ware.

It will be seen from this table that the imports are practically all pottery. Of the total $11,488,411 in 1904 only $218,170, or 1.90 per cent, is of the coarser clay products, brick and tile.

The following table shows the exports of clay products from the United States from 1895 to 1904:

Exports of clay wares of domestic manufacture from the United States, 1895–1904.

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
1904	25,012	179,866	407,519	587,385	697,381	94,358	791,739	1,379,124

It will be noted from this table that the value of the exports of brick increased from $439,277 in 1903 to $587,385 in 1904, both varieties of brick reported, building and fire, showing increases, the former from $63,774 in 1903 to $179,866 in 1904, the latter from $375,503 in 1903 to $407,519 in 1904.

The pottery exports also show an increase from $589,001 in 1903 to $791,739 in 1904, an increase of $202,738, or 34.42 per cent. This is the largest export recorded during the period covered by the table. The value of fire brick exported in 1900, 1901, and 1902 exceeded the value of that exported in 1904.

In addition to the foregoing, pottery of foreign manufacture to the value of $32,640 was exported in 1904, and to the value of $19,411 in 1903, and of $18,989 in 1902.

CLAY.

PRODUCTION.

The following tables show the production of clay in 1903 and 1904. 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. In 1904 the table does not distinguish the clay sold in the raw state from that prepared by the miner before being sold. It will also be noticed that the classification by varieties in 1904 is slightly different from that in 1903. The paper and slip clay being in classes commercially by themselves, they have been given places on the card of inquiry.

From these tables it will be seen that the total clay product of the country in 1904 was 1,508,752 short tons, valued at $2,320,162, as compared with 1,641,835 tons, valued at $2,594,042 in 1903, a decrease in quantity of 133,083 tons, or 8.11 per cent, and in value of $273,880, or 10.56 per cent.

As heretofore, New Jersey is the leading clay-producing State, marketing 415,850 tons, or 27.56 per cent, valued at $578,278, or 24.92 per cent, in 1904; in 1903 this State produced 493,254 tons, or 30.04 per cent, valued at $684,625, or 26.39 per cent.

Pennsylvania was second in value of product in 1903, producing 170,963 tons, or 10.41 per cent of the total, valued at $355,128, or 13.69 per cent of the total, as compared with 196,977 tons, or 13.06 per cent, valued at $323,624, or 13.95 per cent in 1904. Missouri was a close third, however, to Pennsylvania, in 1904 producing 185,508 tons, or 12.30 per cent, valued at $318,498, or 13.73 per cent. In 1903 Missouri produced 191,122 tons, or 11.64 per cent of the total, valued at $345,537, or 13.32 per cent. It will be noted that of the States separately enumerated in the following table only 5 showed an increase in 1904 over 1903, all of which, except Vermont, are located in the South.

Clay mined and sold in the United States in 1904.

[Quantity in tons of 2,000 pounds.]

State.	Kaolin.		Paper clay.		Slip clay.		Ball clay.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama								
Arizona[a]	10,310	$85,770	(b)	(b)	659	$2,262		
California								
Colorado								
Delaware	(c)	(c)						
Florida							11,351	$51,098
Georgia			18,938	$76,593				
Illinois								
Indiana								
Kentucky							(c)	(c)
Maryland	(c)	(c)						
Missouri	404	3,823						
Montana								
New Jersey			(c)	(c)			13,478	31,681
New York					(c)	(c)		
Ohio					(c)	(c)		
Pennsylvania	(c)	(c)	4,507	23,615				
South Carolina			46,008	166,804				
Tennessee							(c)	(c)
Texas								
Vermont	(c)	(c)	(c)	(c)			(c)	(c)
Virginia	(c)	(c)						
West Virginia								
Other States[d]	30,493	214,989	52	369	3,278	9,680	21,352	59,249
Total	41,207	304,582	69,505	267,381	3,937	11,942	46,181	142,028

[a] Including Connecticut, Iowa, Massachusetts, Michigan, North Carolina, North Dakota, Oregon, Utah, Washington, Wisconsin, and Wyoming.
[b] Paper clay for the States included with Arizona is included in miscellaneous.
[c] Included in Other States.
[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.

Clay mined and sold in the United States in 1904—Continued.

State.	Fire clay.		Stoneware clay.		Miscellaneous.[a]		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	22,529	$12,628			16,130	$4,200	38,659	$16,828
Arizona [b]	6,204	8,204	322	$261	8,209	12,079	25,704	108,576
California	17,710	12,405	(c)	(c)	8,100	14,600	27,010	28,905
Colorado	9,700	15,751	3,650	2,250	20,958	18,263	34,308	36,264
Delaware	(c)	(c)					51,678	122,620
Florida					6,000	12,000	17,351	63,098
Georgia	3,080	4,557	(c)	(c)	300	2,400	22,388	83,590
Illinois	55,922	43,863	23,320	18,843	9,723	8,380	88,965	71,086
Indiana	27,187	25,446	(c)	(c)	3,230	972	33,077	29,168
Kentucky	18,350	14,947	(c)	(c)	2,240	8,172	29,580	48,129
Maryland	5,050	4,395	(c)	(c)	2,050	600	8,200	11,120
Missouri	181,209	311,970	3,895	2,705			185,508	318,498
Montana	7,033	7,918			300	75	7,333	7,993
New Jersey	318,000	428,849	12,165	23,092	72,185	94,464	415,850	578,278
New York	4,596	5,901	(c)	(c)	3,000	3,700	11,824	19,731
Ohio	128,498	110,715	23,531	18,956	17,860	7,059	169,939	136,780
Pennsylvania	155,765	193,397	3,485	1,475	18,285	12,883	196,977	323,624
South Carolina	(c)	(c)			1,900	1,800	49,158	173,854
Tennessee	23,012	26,074	10,100	10,050	1,800	2,250	47,262	72,599
Texas	(c)	(c)	494	671			2,227	3,271
Vermont	875	1,625					3,907	25,326
Virginia	(c)	(c)			750	375	1,469	6,066
West Virginia	40,076	34,482	(c)	(c)			40,378	34,758
Other States [d]	43,822	42,926	5,342	5,601			(e)	(e)
Total	1,068,598	1,306,053	86,304	83,904	193,020	204,272	1,508,752	2,320,162

[a] Including bentonite, brick clay, cement shale, clay used for boiler covering, pipe clay, pottery clay, road metal, siliceous clay, terra cotta clay, and wad clay.

[b] Including Connecticut, Iowa, Massachusetts, Michigan, North Carolina, North Dakota, Oregon, Utah, Washington, Wisconsin, and Wyoming.

[c] Included in Other States.

[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] The total of Other States is distributed among the States to which it belongs, in order that they may be fully represented in the totals.

Production and value of clay in the United States in 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							15,184	$69,328
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	25,409	111,317

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	$3,282		
California	29,097	30,199			3,950	4,100		
Colorado	12,910	12,860	([c])	([c])	1,810	1,958		
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	$13,753	18,024	$14,592	....	....
Indiana	31,614	30,637	(a)	(a)	(a)	(a)	....	....
Kentucky	44,288	36,253	(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	....	....	16,184	71,328
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	1,641,835	2,594,042

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.

The tables following show the production of clay in the United States in 1903 and 1904, by varieties. As in the general table, all the varieties decreased in 1904. This decrease may be more apparent than real, however, in the case of kaolin, which decreased in value from $357,785 in 1903 to $304,582 in 1904, since some of the paper clay reported in 1904 was undoubtedly reported as kaolin in 1903. Ball clay showed a decrease from $217,344 in 1903 to $142,028 in 1904, a loss of $75,316, or 34.65 per cent. Fire clay also showed a decrease from 1,183,926 tons in 1903 to 1,068,598 tons in 1904, a loss in quantity of 115,328 tons, or 9.74 per cent, and from $1,474,260 in 1903 to $1,306,053 in 1904, a loss in value of $168,207, or 11.41 per cent. The stoneware clay decreased from 100,747 tons in 1903 to 86,304 tons in 1904, a loss in quantity of 14,443 tons, or 14.34 per cent, and from $114,759 in 1903 to $83,904 in 1904, a decline in value of $30,855, or 26.89 per cent. The decrease in the miscellaneous class may be accounted for by the fact that many of the clays included in this item in 1903 have been credited to their proper class under the new classification in 1904.

Production and value of clay in the United States in 1903 and 1904, by varieties.

1904.

Variety.	Quantity.	Value.
	Short tons.	
Kaolin	41,207	$304,582
Paper	70,505	276,381
Slip	3,937	11,942
Ball	46,181	142,028
Fire	1,068,598	1,306,053
Stoneware	86,304	83,904
Miscellaneous	192,020	195,272
Total	1,508,752	2,320,162

1903.

Variety.	Raw.		Prepared.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Kaolin	530	$1,405	49,725	$356,380	50,255	$357,785
Ball	66,309	106,027	25,409	111,317	91,718	217,344
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	190,392	364,531	24,797	65,363	215,189	429,894
Total	1,292,115	1,616,216	349,720	977,826	1,641,835	2,594,042

IMPORTS.

The following table shows the imports of clay into the United States from 1885 to 1904:

Classified imports of clay, 1885–1904.

Calendar year.	Kaolin or china clay.		All other clays.						Total.	
			Unwrought.		Wrought.		Common blue.			
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
1885	10,626	$83,722	9,736	$76,899	3,554	$29,839	....	....	23,916	$190,460
1886	16,590	123,093	13,740	113,875	1,654	20,730	....	....	31,984	257,698
1887	23,486	141,360	17,645	139,405	2,187	22,287	....	....	43,318	303,052
1888	18,150	102,050	20,604	152,694	6,832	53,245	....	....	45,586	307,989
1889	19,843	113,538	19,237	145,983	8,142	64,971	....	....	47,222	324,492
1890	29,923	270,141	21,049	155,486	2,978	29,143	....	....	53,950	454,770
1891	39,901	294,458	16,094	118,689	6,297	56,482	....	....	62,292	469,629
1892	49,468	375,175	20,132	155,047	4,551	64,818	5,172	$59,971	79,323	655,011
1893	49,713	374,460	14,949	113,029	6,090	67,280	4,304	51,889	75,056	606,658
1894	62,715	465,501	13,146	98,776	4,768	60,786	2,528	28,886	83,157	653,949
1895	75,447	531,714	18,419	125,417	5,160	60,775	3,869	40,578	102,895	758,484
1896	76,718	536,081	13,319	88,029	4,514	56,701	4,983	54,695	99,534	735,506
1897	71,938	493,431	9,405	56,264	7,839	52,232	4,562	50,954	93,744	652,881
1898	85,586	573,595	16,130	98,434	1,412	24,959	5,312	58,280	108,440	755,268
1899	92,521	615,717	19,614	118,679	1,716	31,948	9,223	106,618	123,074	872,962
1900	111,959	698,720	21,626	126,203	3,195	45,431	7,327	92,013	144,107	962,367
1901	117,756	663,379	27,597	156,838	5,707	75,721	6,136	73,839	157,196	969,777
1902	133,062	883,092	25,831	138,032	2,680	47,093	6,978	86,588	168,551	1,154,805
1903	140,257	898,573	29,188	152,018	2,433	36,211	9,076	110,794	180,954	[a] 1,198,418
1904	142,878	891,708	22,680	123,241	1,217	25,026	4,699	50,364	171,474	1,090,339

[a] Includes clay not otherwise provided for, valued at $822, but for which no quantity is reported.

SAND-LIME BRICK.

The following table shows the production of sand-lime brick in the United States in 1904:

Production of sand-lime brick in the United States in 1904, by States.

State.	Number of operating firms reporting.	Common brick.		Front brick.		Fancy brick.		Total value.
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
		Thousands.		*Thousands.*		*Thousands.*		
Alabama	3	(a)	(a)	1,114	$11,490			$16,126
Arizona, South Dakota, Washington, and Wisconsin	4	4,878	$35,400	400	5,000			40,400
Arkansas, Iowa, Kansas, and Texas	6	7,497	51,855	8,315	72,533			124,388
California	4	2,969	22,848	92	1,171	(a)	(a)	24,044
Delaware, Maryland, New Jersey, and Virginia	5	4,388	30,527	300	3,200			33,727
Florida, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee	9	4,494	32,808	1,735	20,473			53,281
Indiana	4	11,000	52,175	(a)	(a)			53,175
Michigan	10	9,886	64,034	580	5,234	(a)	(a)	69,765
New York	5	3,403	20,571	(a)	(a)			26,233
Ohio	3	(a)	(a)	(a)	(a)			1,494
Pennsylvania	4	(a)	(a)	(a)	(a)			20,495
Other States [b]		2,131	16,016	1,935	17,271	20	$522	(c)
Total	57	50,646	326,234	14,471	136,372	20	522	463,128
Average value per M			6.44		9.42		26.10	

[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] 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.

In 1903 returns were received from 16 plants, showing a marketed product of 20,860,000 sand-lime brick, valued at $155,400, or $7.45 per thousand. In that year no effort was made to collect statistics of brick by variety, hence this average value was higher than the average value of the common brick in 1904 and lower than that of front. In 1904 returns were received from 57 plants, giving a total value of products of $463,128. Every plant operating in the United States in 1904, except those beginning very late in the year and from which no sales were made, are included in this table. The number of plants increased from 16 in 1903 to 57 in 1904, and the total number of brick increased from 20,860,000 in 1903 to 65,137,000 in 1904, valued at $463,128, or $7.11 per thousand. Of these 57 plants there are three each located in Alabama and Ohio; one each in Arizona, Delaware, Kansas, Kentucky, Louisiana, Maryland, Mississippi, New Jersey, North Carolina, South Dakota, Tennessee, Texas, Washington, and Wisconsin; four each in California, Indiana, and Pennsylvania; ten in Michigan; five in New York; and two each in Arkansas, Florida, Iowa, South Carolina, and Virginia. In 1903 Michigan had three; California, New York, South Dakota, and Texas had two each, and Arizona, Maryland, New Jersey, North Carolina, and Pennsylvania had one each. Michigan, with ten plants and an output valued at $69,765, was the leading producing State in 1904. Indiana was the next largest producer, with product valued at $53,175. New York appears to be next, with a product valued at $26,233.

CEMENT.[a]

INTRODUCTION.

To those who made large purchases of cement in 1904 the low prices which prevailed were doubtless satisfactory; but to the manufacturers of cement in the United States the year was not an encouraging one. Never in the history of the industry have prices been so extraordinarily depressed. In midsummer several of the mills in the Lehigh district were quoting selling prices which were below the cost of production and lower than any quotations ever before made by these mills. Later in the season there was a slight reaction, but the year closed with prices at a discouraging figure.

The cutting of selling prices in Portland cement naturally operated to lower the selling price and reduce the output of natural-rock cement, with the result that the production of the natural-rock cement mills for 1904 was very much smaller than that for 1903. These facts and the general uncertainty as to an immediate reaction in the cement market acted as a deterrent to a number of companies whose plans for building cement plants were already well developed, and many mills which were to have been built in 1904 were numbered instead among the projects which await a steadier market, better prices, and an increased number of orders for cement.

The building of the Panama Canal, which will require more than 12,000,000 barrels of cement; the rebuilding of the city of Baltimore, especially along the water front; the enormous increase in the consumption of cement caused by its use in the various forms of concrete construction, and the increasing demand throughout this country for cement sidewalks point toward a brighter outlook for the industry in the immediate future.

[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.

ACKNOWLEDGEMENTS.

As the statements of statistics and the details of production set forth in this report are obtained directly from the owners and managers of cement plants in the United States, except in so far as they relate to foreign production and conditions, it will be readily understood that cordial and complete cooperation between the United States Geological Survey and the gentlemen in charge of the cement industry in this country is necessary to insure a comprehensive and approximately accurate report. Such cooperation has been almost invariably accorded, and for it the writer here expresses sincere thanks.

TOTAL PRODUCTION.

The entire production of hydraulic cement in the United States in 1904 increased only 1,776,117 barrels over that for 1903, as a result of the continuation of the condition of the market outlined at the close of 1903 in the report made by this Bureau on the production of cement in 1903.

The total production of cement for 1904 was 31,675,257 barrels, valued at $26,031,920, as against a total production in 1903 of 29,899,140 barrels, valued at $31,931,341, which is a gain of a little less than 2,000,000 barrels in the quantity of cement produced, and a loss of nearly $6,000,000 in value.

The production of Portland cement in 1904 was 26,505,881 barrels, valued at $23,355,119.

The production of natural-rock cement in 1904 was 4,866,331 barrels, valued at $2,450,150.

The production of Puzzolan or slag cement in 1904 was 303,045 barrels, valued at $226,651.

PORTLAND CEMENT.

PRODUCTION.

Following is a table showing the quantity and value of the production of Portland cement in the States manufacturing this product in 1902, 1903, and 1904:

Production of Portland cement in the United States in 1902, 1903, and 1904, by States.

State.	1902.[a]			1903.[a]			1904.[b]		
	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.
		Barrels.			*Barrels.*			*Barrels.*	
Alabama	1	....	....	1	....	....	1	....	....
Arkansas	1	....	....	1	....	....	1	....	....
California	2	294,156	$431,910	3	631,151	$1,019,352	3	1,014,558	$1,446,909
Colorado	2	82,044	105,016	1	258,773	436,535	1	490,294	638,167
Georgia	1	....	....	2	....	....	2	....	....
Illinois	4	767,781	977,541	5	1,257,500	1,914,500	5	1,326,794	1,449,114
Indiana	3	536,706	628,244	3	1,077,137	1,347,797	4	1,350,714	1,232,071
Kansas	1	830,050	1,017,824	1	1,019,682	1,285,310	2	2,643,939	2,134,612
Kentucky	....	....	....	....	....	....	1	....	....
Michigan	10	1,577,006	2,134,396	13	1,955,183	2,674,780	16	2,247,160	2,365,656
Missouri	1	....	....	2	825,257	1,164,834	2	....	....
New Jersey	2	2,152,158	2,563,355	3	2,693,381	2,944,604	3	2,799,419	2,099,564
New York	10	1,156,807	1,521,553	12	1,602,946	2,031,310	12	1,362,514	1,257,561
Ohio	7	563,113	685,571	8	729,519	998,300	7	910,297	987,899
Pennsylvania	15	8,770,454	10,130,432	17	9,754,313	11,205,892	17	11,496,099	8,969,206
South Dakota	1	....	....	1	....	....	1	....	....
Texas	2	165,500	234,950	2	....	....	2	....	....
Utah	1	....	....	1	....	....	1	....	....
Virginia	1	334,869	433,286	1	538,131	690,105	1	864,093	774,360
West Virginia	....	....	....	1	....	....	1	....	....
Total	65	17,230,644	20,864,078	78	22,342,973	27,713,319	83	26,505,881	23,355,119

[a] The States combined for 1902 and 1903 are mentioned in the text of the reports for those years.
[b] The States combined for 1904 are given in the text below.

As heretofore, States having but one producing cement plant have the figures showing their output combined with the figures for some other States to avoid exposing individual productions, which are not published except in combinations to make State totals, unless for some especial reason and with the full permission of the persons concerned.

In the table above the State combinations are as follows: Alabama, Georgia, West Virginia, and Virginia are reported together; the products of Kansas and Missouri are given in combination; and Colorado, Utah, and Texas have their products combined. In each case the combined product is given in connection with the State which was the largest producer.

For the year 1904, one new State is added in the table showing where the Portland cement plants of the United States are located, for the reason that although Kentucky did not produce Portland cement in 1904, the plant for that purpose was practically completed in that year. No new plants were started up in States not already recorded as producers of Portland cement.

The States stand in the same order of rank for 1904 that they held in 1903, so far as the leading producers of Portland cement are concerned. Pennsylvania, the heart of this branch of the cement industry, still holds first place, with a product which is more than 40 per cent of the total quantity of cement manufactured in 1904. She increased her lead over that of the previous year by 1,741,786 barrels, and stands 8,696,680 barrels ahead of New Jersey, which ranks second, with a production amounting to 10.56 per cent of the whole. Michigan is still in the third place, her production being a trifle less than 8½ per cent of the total quantity of cement manufactured. New York was the fourth producer of Portland cement in 1904, having made about 5 per cent of the entire production.

When the pioneer cement plants turned out a few thousand barrels as a good year's work, the lead of a million or two barrels in a State would have meant much more than it did in 1904, when a number of plants—notwithstanding 1904 was a bad year—ran up into the millions of barrels for their individual production.

The States included in all other sections in the following table are Alabama, California, Colorado, Georgia, Illinois, Indiana, Kansas, Missouri, Texas, Utah, Virginia, and West Virginia, together with such counties in Pennsylvania as are not included with Lehigh and Northampton counties.

As in the similar table for 1903, Warren County, N. J., is not included with the Pennsylvania counties, but is included in the separate statement of the output of New Jersey.

Following is a table showing 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	6.7
Lehigh and Northampton counties, Pa., and Warren County, N. J.	5	201,000	59.9	15	6,153,629	72.6	17	10,829,922	62.9
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	14.2	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.			1904.		
	Number of works.	Quantity.	Per cent.	Number of works.	Quantity.	Per cent.
		Barrels.			*Barrels.*	
New York	12	1,602,946	7.2	12	1,362,514	5.1
Lehigh and Northampton counties, Pa	13	9,631,541	43.1	15	11,411,620	43.1
New Jersey	3	2,693,381	12.1	3	2,799,419	10.6
Ohio	8	729,519	3.3	7	910,297	3.4
Michigan	13	1,955,183	8.7	16	2,247,160	8.5
All other sections	29	5,730,403	25.6	30	7,774,871	29.3
Total	78	22,342,973	100.0	83	26,505,881	100

THE PORTLAND CEMENT INDUSTRY, BY STATES.

The production of Portland cement in the United States in 1904 was confined to 17 States, two other States, with but a single plant each, being nonproductive. In detail, the State production was as follows:

Alabama.—This State has but one plant manufacturing Portland cement, and that plant ran slightly behind its production for the previous year. The mills were closed down for several months, during which time alterations and improvements were completed. The only other plants in the State are manufacturers of slag cement, though there is a project for another Portland-cement plant which will be located at Selma, where well-known deposits of limestone suitable for use in the production of Portland cement occur abundantly. As yet, however, the mill has not been built. The other cement factories in Alabama were both active in 1904.

Arkansas.—The only plant in the State of Arkansas which has ever produced cement was idle throughout the year 1904. This mill has abundant material for the economical production of cement, and is built in a locality where no immediate neighbors exist to create competition. The low price of cement during the year and lack of funds with which to operate were the causes responsible for the idleness of the mill.

California.—There has been a steady and very marked increase in the output of cement from California within the last few years. In 1902 the returns showed but little more than a quarter of a million barrels of Portland cement produced in the State. In 1903 this amount was increased to more than a half million barrels, and in 1904 the total production for the State ran up to more than a million barrels. This quantity of Portland cement is the output of the three plants located in California. Of these three mills, one was idle nearly six months undergoing repairs and remodeling, one was closed for a short time that it might be overhauled, and the other ran practically on full time for the year. The increasing market for American cements in the Pacific States has had a marked effect on the imports of cement on that coast, and the entire success of the home product is each year more fully assured.

Colorado.—There was only one plant producing Portland cement in Colorado in 1904, and this plant had a much larger output than that recorded for the preceding year. This company, it will be remembered, absorbed its only competitor in the State in 1902, and increased its own capacity greatly thereafter. There is now another company in Colorado that has at present some facilities for burning cement, and the writer is informed by them that the erection of a large, modern Portland cement plant is contemplated in the near future. As about 85 per cent of the cement made in the United States is manufactured east of the Mississippi River, and as the freight rates on cement shipped to the west from eastern factories are heavy, there should be sufficient room for a number of new cement mills in Colorado, where raw materials for the industry are abundant.

Illinois.—There were four active Portland cement factories in Illinois during 1904, and one factory which remained idle on account of the condition of the cement market. Of the four active plants, two were closed down three months for repairs, and the other two ran on full time throughout the year. The Illinois Steel Company did not complete its new plant at Buffington, Ind., in time to manufacture cement, until January, 1905. This plant is more fully described as to its location in the detailed account of the State of Indiana; though that it is built just across the State line dividing Illinois from Indiana, instead of just within it, is a mere chance and due to the fact that at the time when the building of an additional plant was desirable, there was no other land available for purchase by the Illinois Steel Company which was as near to its mill at South Chicago as the site at Buffington. The enterprise and the capital invested in the Indiana factory belong entirely to Illinois. The three other cement plants in this State produce only natural-rock cement.

Indiana.—The Portland cement industry was fairly prosperous in this State in 1904, notwithstanding the uncertain market, and the three plants which contributed to the total production had a larger output than they had in 1903. All three of the mills ran practically without interruption through the entire year. The plant at Mitchell was not closed down at all, and the company owning it expects to build a second factory there in 1905, still further to increase its Indiana production of cement. The plant at Bedford is now in operation and is to be active through the current year. It was not started up until just after the close of 1904. It has a capacity of 2,000 barrels of Portland cement per day, and the limestone and shale used for manufacturing are both to be had on the grounds where the mill stands. The new plant erected at Buffington by the Illinois Steel Company is located just without the Illinois State line, instead of just within it, as are the two other plants owned by the company. The factory is completed, and was started up in January, 1905. It has sixteen rotary kilns, each 80 feet long by 7 feet high at the fire end and 5 feet 6 inches at the stack end, capable of turning out sufficient clinker to make 4,500 barrels of Portland cement per day. Power for the electric motors is supplied from the South Chicago works, 10 miles distant, at less than a 4 per cent loss. The current is supplied by two 2,000-kilowatt generators, and steam is furnished by boilers fired with waste gases from the blast furnace in South Chicago. As in the company's slag-cement factory at North Chicago, Ill., and its Portland cement plant at South Chicago, Ill., the raw materials used are obtained in the State of Illinois, the same quarry furnishing limestone for all three of the plants. The railroad used in shipping material from Chicago to Buffington also belongs to the company owning the cement plants. Therefore, although it is necessary, in order to preserve the integrity of this report as to totals of State production, to credit the cement manufactured at Buffington to Indiana, yet the fact that this new plant is but the third branch of a large Illinois company and that all the raw materials used, as well as the money invested, come from that State, should not be overlooked.

There are four other Portland cement companies reporting from Indiana besides the natural-rock cement producers. Of these four, one has dissolved, one has gone into the hands of a receiver, and one has not yet been satisfactorily capitalized, though there is a good prospect that it will be in the coming year. The fourth company is one which will build a Portland cement plant at Speeds. As yet only the preliminary work has been done, but the factory will probably be finished in 1905. It will have two rotary kilns, which will give a capacity of from 500 to 600 barrels of cement per day. Ball and pebble mills for both raw materials and clinker will be installed. Cement will be produced from the limestone underlying the natural cement rock in a quarry owned by this company, and from a shale which lies about 3 miles west of the quarry. The shale is to be brought to the plant by means of a narrow-gauge railroad built for that purpose.

Kansas.—For the first time Kansas has more than one cement plant devoted exclusively to the manufacture of Portland cement. The first plant to produce that article in the State was that of the Iola Portland Cement Company, whose first output was made in 1900. The second plant, that of the Kansas Portland Cement Company, has its first record for producing Portland cement in 1904. Its mills, which have a capacity of about 1,200 barrels per day, were started in February, and the plant continued to operate during the rest of the year. It is well located from an economic standpoint. The raw materials used in producing cement are obtained near the mill, and natural gas is the fuel used. The result of the first year was unusually good. There are two Portland cement plants now under construction in this State, and if the conditions in the cement world justify such a step they will both be completed and in active operation before the close of 1905. The other and older plants in Kansas produce only natural-rock cement.

Kentucky.—This State, for so many years associated with cement only as a producer of and selling center for the famous natural-rock product known as Louisville cement, has now a completed plant for the production of a first-class Portland cement. The factory is located at Kosmosdale, which was formerly known as Riverside, and is only a few miles from Louisville, in which city are the company's offices. The raw materials used are limestone and clay; the quarry whence the limestone is obtained lies near the Ohio River, about 30 miles above the plant, and the limestone is brought to the mills by means of river transportation, and the clay beds, which show clay of unusual excellence, underlie the plant itself and extend over more than 800 acres of adjacent land, all of which is owned by the company operating the cement plant. Pulverized coal is the fuel used, and it also is brought to the mills by river transportation. The buildings of the entire plant are substantial, being of structural steel walled in with cement mortar on expanded metal, and making a construction which is practically fireproof. There is also an especial provision for clinker storage, which is regarded as valuable, since the ripening of clinker is known to play an important part in the constancy of composition in Portland cement. Electric power is used for driving the machinery and for lighting many of the houses built by the company for its employees. These houses are of concrete construction. As at present completed, the plant has a producing capacity of 2,500 barrels of cement per day, but it is the intention of the owners to increase this capacity to 5,000 barrels per day in the near future, and the buildings have been constructed with a view to such an extension. Philadelphia capital is back of this enterprise, and the plant is said to have cost nearly a million dollars. At the time of the writer's visit to Kosmosdale the buildings and factory were incomplete, but at the present time [May, 1905] they are finished and the mills are in operation.

Michigan.—Of the sixteen Portland cement plants in this State in 1904, thirteen produced the output of cement for the year. One of the plants was not completed until June, and several of the older plants were shut down for a much longer period than is usual during the winter. One plant had a disastrous fire and was closed more than half the year, in order to rebuild, and another was compelled to close down while the machinery was undergoing necessary repairs. Another company closed its mills for several months, in order to make extensive improvements, and several factories were closed because of low prices, lack of orders, and overproduction. Notwithstanding these facts Michigan holds her place as the third largest producer of Portland cement in the United States, and her production for the year is in excess of that for the preceding year. There are several companies in this State that report that they are about to build cement plants, and there are a number of new plants, now practically complete, which have not been started up. One factory is in the hands of a receiver; and one company reports that its project is abandoned, and that the money subscribed has been paid back. The writer desires to call attention to the fact that on page 32 of the pamphlet upon the production of cement in 1903, issued by this Bureau in 1904, there is a line mentioning the name of the White Star Portland Cement Company as being among those companies which had abandoned the intention of building cement plants. Later information received from this company states that such is not the case; that the intention to construct a factory still exists, and that the company is still pursuing its enterprise. This company should properly come under the head of those whose projects have not yet taken the material shape of a cement factory.

A plant reported as one which will be completed late in 1905 or early in 1906 is that of the Standard Portland Cement Company. This organization owns 3,000 acres of marl lands in Benzie County, besides owning about 1,000 acres of limestone and cement rock property in Charlevoix County. The first project was to utilize the marl in producing Portland cement, but having become convinced that the rock process of manufacture would be a less expensive one the company decided to build a cement plant on the lands near Charlevoix and to make cement from limestone and shale. The holdings of the company include shale lands in Charlevoix County. Several large limekilns are also being built, as it is the present intention of the company to produce lime as well as Portland cement.

Missouri.—The two factories which made Portland cement in this State in 1904 were both active throughout the year, save for some trifling interruptions for necessary repairs. The output was in advance of that for the previous year. The plant at Louisiana is still in process of construction, and its completion will hardly be accomplished before the close of 1905. It is now expected by the owners that the mill will be started in January, 1906. There is no production of natural-rock cement in this State, and it is only within the last three years that any kind of hydraulic cement was produced here.

New Jersey.—The record for New Jersey in 1904 does not vary greatly from that for 1903. There were seven companies reporting, but of them only three were cement producers. Of these three, two ran ahead of their production for the previous year, and one fell behind. Of the others, two had not yet completed their plants; one was idle; and one had given up its organization and abandoned its intention of building a factory, at least for a time. The plant at Stewartsville again suffered from fire in its coal building, caused, presumably, by a bit of oily waste which took fire while going through the drier with the coal. It then dropped into the bottom of an inclosed elevator and set fire to the coal, which generated gas until the casing was filled, when it exploded. This is a much more unusual cause for fire or explosion than the cause which led to the same results in 1903. To avoid a recurrence of either accident, the coal at the plant is not now dried with direct heat, but by means of steam instead. It is the present intention of the company owning this plant to increase its capacity to 5,000 barrels of cement per day during the latter part of 1905. The

State production of New Jersey again shows an increase over that for the preceding year.

New York.—Three of the twelve companies that produced Portland cement in New York State in 1904 also produced natural-rock cement, and nine companies manufactured Portland cement exclusively. Several of these nine companies were idle the greater part of the year, and a number of them closed down their plants for shorter periods of time. Among the many causes that entered into the shutting down of plants in this State during the year were bad market conditions, lack of orders, some installations of new machinery, low prices of cement, legal complications, low water, labor troubles, coal shortage, full storage bins, and fire. One plant which has reported a production of cement for many years was idle throughout the year, overhauling the mills and preparing to install rotary kilns instead of the upright kilns, in which heretofore the Portland cement has been burned, and one plant was sold outright. The factory at Wayland was burned down on Christmas Day, the plant being totally destroyed. The origin of the fire is unknown, and the loss is about $140,000, only a part of which is covered by insurance. It is not yet decided whether the plant will be rebuilt or not. The number of factories engaged in the manufacture of Portland cement in New York was the same in 1903 and 1904, but the quantity of cement produced was less in 1904 than it was during the preceding year. A large iron company in the State now contemplates the erection of a mill for the production of slag cement, in order to make use of the slag from the foundry. This plan has not yet been definitely decided on, however.

Ohio.—The decline in the cement market throughout the year 1904 affected the production of cement in Ohio, although the Portland cement manufactured for that year was more than that produced in 1903. The plants which were closed down for repairs and new machinery were not opened again as speedily as possible, and one plant remained idle during the entire year because of low prices. There were seven factories in operation, all of which produced Portland cement exclusively. The two plants producing slag cement were active, as was the only factory in the State which produced natural-rock cement. The new plant of the Wellston Company, which took the place of that destroyed by fire, was started up in July, and in November it was found necessary to close it down in order to install additional machinery and engine power. The quarry belonging to this company is at Oreton, about 16 miles from Wellston, and here limestone and coal are mined from the same hill. The shale, too, is immediately adjacent. The company owns a very large and valuable tract of land containing almost unlimited deposits of materials well adapted to the production of an excellent Portland cement, and the erection of another large plant, to be located at Oreton, is being considered.

Pennsylvania.—The number of mills operated for the production of Portland cement in this State in 1904 was seventeen, and the quantity of cement produced was an increase of nearly 2,000,000 barrels over the quantity manufactured in 1903. Five of the seventeen active factories produced both natural rock and Portland cement. Two companies that had reported themselves in 1903 as about to build cement factories abandoned their plans entirely in 1904. Three plants were idle during the year, and five are reported as being under construction and likely to become active producers in the near future. The National Portland Cement Company's plant at Martins Creek, which was not completed in 1904, will probably be active in 1905. It is a large plant, extending over more than 5 acres of ground. There are already installed sixteen rotary kilns, each having a capacity of 200 barrels per day. The factory is well equipped for transportation, being located near the Pennsylvania; the Delaware, Lackawanna and Western; and the Lehigh and New England railroads. Electric power is used throughout the plant. The new mill at Penn-Allen was started up about the middle of the year, and made a very satisfactory production during the remaining six months. Several of the active plants ran all the year, but the majority of those reporting a production of cement for 1904 also report idleness for some part of that year, ranging from periods of one to ten months in length. A comparison of the values of the total State productions for 1903 with 1904 will show that the falling off in prices of Portland cement struck most heavily upon the eastern market. The 9,754,313 barrels of cement produced in Pennsylvania in 1903 had a value of more than $11,000,000, while the more than 11,000,000 barrels of cement made in 1904 sold for less than $9,000,000.

South Dakota.—There is but one cement plant in South Dakota, and it is devoted exclusively to the production of Portland cement, using as materials for manufacture chalk and clay. In 1904 this factory did not have a production, owing to an entire remodeling of the plant and the installation of more modern machinery than that heretofore used. The five vertical kilns heretofore used in this mill are now replaced by four rotary burners, each 100 feet in length and 7 feet in diameter, and in place of millstones in the grinding department six Kent grinding mills have been set up. Coal drying and grinding machinery has been put in and the boiler capacity doubled. Under the present process of manufacture coal will entirely replace the coke formerly used, and an increase of about four times the former average output is confidently anticipated by the company in 1905. There was in 1903 a project to erect a second cement plant in another part of

South Dakota, but the organizers of the plan report postponement of their enterprise until such time as better prices are established in the cement market.

Texas.—In 1904 one of the three cement plants in this State was idle, one was closed nearly half the year but produced a large quantity of Portland cement during the remaining months, and the third manufactured both natural-rock and Portland cement. This plant was closed down during a part of the year. The activity of the factory purchased by a Kansas company and remodeled during the previous year materially increased the total State production.

Utah.—The output of Portland cement made by the single cement plant in Utah was more than twice as large in 1904 as it was in 1903, notwithstanding the fact that it was shut down for several months during 1904. In 1903 the plant was rebuilt and its capacity increased, so that the mills now have four rotary kilns, two of which are 60 feet and the other two 50 feet in length.

Virginia.—The report of this State in 1904 is practically a repetition of its report for 1903 except for the increase in production. The only plant producing Portland cement had a very successful run and was active all the year, with the result that its production showed a marked increase over that for 1903. This company uses limestone and shale as its raw materials, and has now ten active rotary kilns, 60 feet long by 6 feet in diameter. There are no new plants reported, and the only other factories in the State manufacture only natural-rock cement.

Washington.—The plant for producing Portland cement in the State of Washington is still a probability, though a large tract of land has been purchased near Seattle for this purpose. If in 1905 the increased demand for and higher prices of cement materialize, it is not unlikely that the cement plant which has been promised in this State for some time past will be built, and that Washington will enter the field as a competitor in the great northwestern section of the United States where the demand for cement so far surpasses the local supply.

West Virginia.—All of the Portland cement made in this State in 1904 was the product of one factory. Unfortunately this plant had a disastrous fire during the year and was closed down for a little more than six months in order to rebuild and put in some improvements. Even taking this into consideration, however, the factory made a very satisfactory production. The other Portland-cement plant in the State was not started up at any time during the year.

MATERIALS USED FOR PORTLAND CEMENT.

Portland cement in the United States is manufactured from a variety of materials, all of which, in proper chemical combinations, give practically the same resulting product.

These materials are limestone, marl, chalk, argillaceous limestone or cement rock, slag, shale, and clay, which should be so proportioned as to produce a mixture that will come within the prescribed bounds from which a good Portland cement may not depart. Following is a table showing the quantity and value of cement made from the use of these materials and the number of companies using the various kinds in 1904:

Table showing materials used in making Portland cement in the United States in 1904.

Materials used.	Number of companies.	Quantity.	Value.
		Barrels.	
Limestone and cement rock	21	13,902,939	$10,733,588
Limestone and shale	18	5,631,686	4,937,740
Marl and clay	17	3,332,873	3,585,113
Limestone and clay	17	3,141,010	3,546,532
Limestone and slag	3	497,373	552,146
Chalk and clay	2	Idle.	....
Total	[a]78	26,505,881	23,355,119

[a] The five mills not included in this number were either new or inoperative in 1904.

The two plants using chalk as the calcareous material for their cement were both idle in 1904. One of them was remodeled and improved. It is probable that both will be active in 1905.

The figures showing total production of Portland cement in the United States have steadily grown larger during the last decade. The amount of increase shown each year as compared with the previous year is not so large in 1904 as it has been at any time within the three preceding years, as illustrated by the following table:

Production of Portland cement in the United States, with yearly increase, 1895–1904.

Year.	Quantity.	Increase.	Percentage of increase.
	Barrels.	*Barrels.*	
1895	990,324	191,567	24.0
1896	1,543,023	552,699	55.8
1897	2,677,775	1,134,752	73.5
1898	3,692,284	1,014,509	37.9
1899	5,652,266	1,959,982	53.1
1900	8,482,020	2,829,754	50.1
1901	12,711,225	4,229,205	49.9
1902	17,230,644	4,519,419	35.6
1903	22,342,973	5,112,329	29.7
1904	26,505,881	4,162,908	18.6

NATURAL-ROCK CEMENT.

The manufacture of natural-rock cement, which is the oldest cement industry known, was materially decreased in the United States in 1904 by the unprecedented fall in the selling prices of Portland cement. The great difference which has existed between the cost of natural-rock cement and that of Portland cement has hitherto operated in favor of the former, while it has not proven detrimental to the latter. There are many purposes for which the natural-rock cements are equally as good as the artificial product, and in such cases the lower price of the natural-rock article has given it the preference. But when the price of Portland cement fell to a rate scarcely any higher than that at which a first-class natural-rock cement could be purchased the sales of the latter cement naturally decreased. Hence the reduced output of natural-rock cement in 1904. As the process of making artificial cements involves a greater outlay of capital, both for the construction and running of a plant, than that required for the manufacture of natural-rock cement, it is, of course, quite proper that the price should be proportionately higher.

PRODUCTION.

In 1904 the total production of natural-rock cement in the United States amounted to 4,866,331 barrels, valued at $2,450,150, which figures show a falling off of more than 2,000,000 barrels in quantity and of about $1,225,000 in value, as compared with the respective figures for 1903. The same conditions which operated to reduce the production in 1903 prevailed to even a greater extent in 1904.

In arranging the following table, which shows the quantity and the value of natural-rock cement manufactured in the United States in 1904, by States, it has been thought best to make a slight change in the form which has heretofore been used in preparing these reports. This change consists in separately reporting the productions of cement made by the States of Kentucky and Indiana, which productions have heretofore been reported together. In the earlier reports made by this Bureau, when the only production of cement reported by these two States was the natural-rock product made in what is called the Louisville district, embracing territory on each side of the Ohio River and lying in both Kentucky and Indiana, no confusion resulted from such a conjunction of the two States.

But since the marked development of a Portland cement industry in the northern part of Indiana, the building of a large plant for the manufacture of Portland cement in Kentucky near Louisville, the breaking of ground for a Portland cement plant near Sellersburg, Ind., and the projecting of other Portland factories immediately within the Louisville district both in Kentucky and Indiana, the recording of the two States separately seems advisable. Following is the table showing the quantity and value of the natural-rock cement manufactured in the United States in 1902, 1903, and 1904:

Production of natural-rock cement in 1902, 1903, and 1904, by States.

State.	1902.			1903.			1904.		
	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.
		Barrels.			*Barrels.*			*Barrels.*	
Georgia	2	55,535	$31,444	2	80,620	$44,402	2	66,500	$37,750
Illinois	3	607,820	156,855	3	543,132	178,900	3	360,308	113,000
Indiana							13	735,906	367,953
Kentucky	15	1,727,146	869,163	15	1,533,573	766,786	2	264,104	132,052
Kansas	2	160,000	80,000	2	226,293	169,155	2	210,922	79,456
Maryland	4	409,200	150,680	4	269,957	138,619	4	65,000	32,500
Minnesota	2	150,000	67,500	2	175,000	78,750	2	138,000	65,620
Nebraska							1		
New York	19	3,577,340	2,135,036	20	2,417,137	1,510,529	19	1,911,402	1,138,667
North Dakota	1			1			1		
Ohio	2			2	67,025	46,776	1		
Pennsylvania	6	796,876	340,669	7	1,339,090	576,269	5	770,897	298,533
Texas	1			2			1		
Virginia	2	34,000	20,000	2	47,922	25,961	2	93,292	59,619
West Virginia	1	88,475	62,655	1			1		
Wisconsin	2	437,913	162,628	2	330,522	139,373	2	250,000	125,000
Total	62	[a]8,044,305	4,076,630	65	[a]7,030,271	3,675,520	61	[b]4,866,331	2,450,150

[a] The States combined for 1902 and 1903 are noted in the text of the reports for those years.
[b] The States wherein the cement product was combined with that of some other State for 1904 are given in the text below.

The combinations of figures showing State totals of production of natural-rock cement in 1904 are more numerous than those for 1903. In the latter year only the North Dakota figures were recorded in combination with those for two other States, but in the record for 1904 it has been found advisable to combine the figures for North Dakota with those for Minnesota, the figures for Ohio with those for Virginia, and the figures for Texas with those for Kansas. As heretofore, the final statement of the combinations is placed against the name of that State which contributed the largest proportion of cement to the total quantity.

New York has always been the largest producer of natural-rock cement in the United States, and that record remains unchanged in 1904, the returns showing this State to be the only one that produced more than a million barrels.

If the Louisville district had been reported as a whole in 1904 that locality would have occupied second place as a producer of natural-rock cement, as heretofore. But since it has seemed best to divide this district, Pennsylvania holds second place, but exceeds by less than 35,000 barrels the production of Indiana, which stands third in rank.

THE NATURAL-ROCK CEMENT INDUSTRY, BY STATES.

The States mentioned below were not all active producers of natural-rock cement in 1904. There are seventeen States having factories capable of producing such cement, but some of them did not contribute to the total production during the year. Following are the detailed accounts of State production:

Florida.—There was no production of cement in this State in 1904, and the outlook was not sufficiently encouraging to the people interested in the reorganization of the company at River Junction to admit of much development of their plans. The material at this place, which is so well adapted to the manufacture of cement, was described by Mr. Uriah Cummings in 1898 as follows:[a]

Probably the most remarkable natural hydraulic cement rock deposit in the known world occurs near River Junction. From this point the deposit extends for several miles along the left bank of the Appalachicola River, southerly to Aspalaga. On a recent visit to this locality the writer made a careful estimation of this truly remarkable formation. It comprises something over 2,000 acres, and has a thickness of 80 feet above the river. How far it may be below has not been ascertained. Enough is exposed, however, to warrant the assertion that the deposit contains sufficient raw material to produce over two billions of barrels of cement. The material is usually soft enough to cut with a spade, but the lumps, when placed in kilns, harden sufficiently to prevent them from crumbling while undergoing calcination. Several analyses of samples taken from various parts of the formation show a remarkable uniformity of proportions of the ingredients essential to the production of a first-class hydraulic cement. But the distinguishing feature of this deposit consists in its perfect purity of color. The raw material is white, and the manufactured product is as white as the whitest marble. In this respect it is an ideal cement for the architect, as it will not stain the walls of fine masonry. Bricks made of one part of this cement and two parts white sand are in use in many buildings in the South, and they are extremely hard and beautiful. So far as is known to the writer, this is the only deposit of white hydraulic cement material in the world.

Georgia.—There are two plants in Georgia which produce natural-rock cement, and both were in operation during the year. Their combined production was smaller than that for the previous year, and both mills were closed for a short time in order that repairs might be made, and because of the restricted demand for cement. One of these factories is devoted exclusively to the producing of natural-rock cement, while the other is equipped to make both natural-rock and Portland cement. In 1904, however, it had no output of Portland cement, the mills being used only in the manufacture of natural-rock product.

Illinois.—Among other causes which contributed to the reduced production of natural-rock cement in this State in 1904 were strikes by the labor unions that affected the three cement mills. All of these plants were closed down for a number of months, and the output of cement fell materially below that for the preceding year. Of these

[a] Cummings, Uriah, American Rock Cement: Ann. Rept. U.S. Geol. Survey, pt. 6 cont., 1899, pp. 549-550.

plants, the two older ones are run under practically the same management, though they are two entirely distinct and separate organizations in every respect. They have both been remodeled, and have had new grinding machinery installed within the last two years, so that the output of both plants is now ground and pulverized by Smidth ball and tube mills and comminutors, and thus reduced to practically the same fineness as Portland cement. The improved cement from these mills is regarded as one of the best natural-rock cements on the market. The other plants in the State make only Portland cement.

Indiana.—In the State of Indiana there are thirteen mills which were built for the manufacture of natural-rock cement. In 1904 many of them were idle, owing to conditions which have existed for several years in the Louisville district, and which resulted in the formation of a company to control the manufacture and the selling of Louisville cement and to regulate the quota assigned to each mill. In many cases the quota of smaller factories is made for them by one of the large plants, in which event the small place is not started up at all. The general depression in the cement business affected this district as it did other cement-producing localities, and the output was more than half a million barrels short of the quantity produced by the same mills in the previous year. The fall in values was likewise extreme. It is reported to this Bureau by a large manufacturer of natural-rock cement in this district that he is about to build a modern, well-equipped plant for the production of Portland cement during 1905. If the present plans for this plant are carried out the factory will be started up in the late fall or early winter of 1905. It will not, however, interfere with the operation of the plant for producing natural-rock cement.

Kansas.—One of the two natural-rock cement plants in this State suffered from a destructive fire in December, 1903, and was idle for about three months early in the year of 1904, during which time the factory was rebuilt. In the fall there was another temporary shutdown at the plant by reason of overproduction. The other plant ran throughout the year, but not at full capacity. In Kansas the natural-rock cement industry is an old and well-known one, while the production of Portland cement there dates only from 1900.

Kentucky.—In this State the two natural-rock cement plants are situated in the suburbs of Louisville, between the canal and the river, and the rock used by them in making cement is obtained from the ledge of hydraulic limestone which rises out of the river and upon which they are built. They are exceedingly interesting plants. They have a barrel manufacturing department, which is adjacent to and run in connection with the mills, and in which the barrels used for cement shipments are made. The cement rock is burned in the ordinary top-fire, vertical kilns, which are about 30 feet high, and for transportation the river, the canal, and the railroads are immediately adjacent to the mills.

Maryland.—There were only two plants in this State which produced cement in 1904, and they made a very much smaller quantity than was produced by them in the preceding year. A third plant, which has contributed for years to the natural-rock cement production of Maryland, was idle throughout the year because of the low price of Portland cement and the consequent lack of orders for the natural-rock product. The plant located at Hancock, which for two years past has been idle, changed hands in 1904 and is now being remodeled and equipped with the most modern machinery available for the manufacture of natural-rock cement. Materials on the land owned by the new company are under examination to determine whether they are suitable for use in the manufacture of Portland cement. If they are found to be suitable for this purpose, and if the economic conditions are satisfactory, a plant for the production of Portland cement will be erected by the Round Top Company. The cement which for years was manufactured at this plant was known as a reliable article, and was used in the construction of the base and of the first 40 feet of the present Washington Monument, at Washington, D. C.

Minnesota.—The two cement plants in Minnesota manufacture only natural-rock cement, and in 1904 both of them reported productions. In one mill the output ran ahead of that for the previous year, and in the other it fell behind. These plants have both been successfully operated since they first manufactured cement. One of them is about twenty-five years old, and the other was opened in 1895. There are abundant materials in the State for the manufacture of a first-class Portland cement, and plans for their development have been reported to this Bureau.

Nebraska.—The single cement plant in Nebraska was idle in 1904, as it has been for several years past. When active, its production was of natural-rock cement only.

New York.—The State of New York is the well-known center of the natural-rock cement industry, and has been such for more than three-quarters of a century. In 1904 the total production of this article was much smaller than that for the preceding year, owing principally to the low prices already mentioned. There were, however, several minor causes, among which were labor troubles, low water, and closing down for unavoidable repairs. Several plants stood idle through the entire year, for lack of enough orders to pay for starting the factories. Sixteen of the nineteen companies reporting a production of natural-rock cement were engaged in the manufacture of that product exclusively, and the remaining three manufactured both Portland and natural-rock cement. The outlook for manufacturers of cement in this State is encouraging at present, because of the large quantities of cement required in the construction of the canal which is to connect the Great Lakes with the Atlantic Ocean by traversing New York State.

North Dakota.—The single cement plant in North Dakota was active only about half the year in 1904. Difficulties in transportation, caused by the severe winter, were responsible. The tests for this particular brand of natural-rock cement run especially high, and the cement has a reputation for being generally satisfactory.

Ohio.—In 1904 Ohio had but one plant used for the production of natural-rock cement. This factory ran ahead of its output for the previous year and was closed during the year only for holidays and occasionally for slight repairs. The other two plants which in former years were producers of this variety of cement both remained idle. Besides these there are two slag cement plants in the State, and the rest of the mills manufacture Portland cement only.

Pennsylvania.—There were no mills making natural-rock cement only in Pennsylvania in 1904, and all production of such cement came from the five factories having an output of both Portland and natural-rock cement. This production was much smaller both in quantity and in value than that for 1903. The causes which led to such results were practically the same as those which affected other States in the same way. There are in Pennsylvania several new factories under construction and some old ones are being remodeled. Two companies went out of business in 1904 and three were idle all the year.

Texas.—The cement plant at San Antonio, Tex., which produces both natural-rock and Portland cement, ran during the most of 1904, and had a good output, although its production of natural-rock cement was not so large as that for 1903. The only other plant which is equipped for the manufacture of natural-rock cement was idle all the year. The third plant in the State was originally a producer of natural-rock cement, but was sold and remodeled in 1903, and in 1904 had a large production of Portland cement.

Virginia.—The State of Virginia did not greatly change her record in 1904 from that made in 1903. In 1904 there were two natural-rock cement plants operating, one of which ran ahead of and one behind the respective outputs for 1903; but the shortage of one was so much less in quantity than the increased production of the other that the total State production shows an advance when compared with that of 1903.

There was one active Portland cement plant in the State in 1904, and one plant which remained idle all the year.

West Virginia.—With the exception of the plant which had a production of Portland cement in this State in 1904 there were no cement factories operating in West Virginia during the year.

There are three other plants located in the State, all of which have been producers of good brands of natural-rock cement. An increase in the demand will doubtless result in at least two of the three becoming active in 1905. The third plant is for sale, and will not be operated by the present owner.

Wisconsin.—In 1904 there were two cement plants in Wisconsin which were operated to produce natural-rock cement, and two new companies were formed to build cement plants. The two active factories had a combined production that was not equal to their combined output for 1903, and both were shut down during the winter months. In one of the mills, repairing a damaged shaft caused a longer shut down than usual. These are the only cement plants in Wisconsin.

CEMENT ROCK QUARRYING AND MINING.

In the chief districts for the production of natural-rock cement, such as the Louisville and the Rosendale districts, two very different processes for obtaining the cement rock are used. The method used in getting out the cement rock from which Louisville cement is made is by blasting or quarrying out the rock. After being tested the rock is stripped and holes are made with steam drills at points of a proper distance apart to result in such an explosion as shall give as large a proportion as possible of pieces of rock sufficiently small in size for use in the kilns without further breaking. These holes are then charged with dynamite and simultaneously exploded by means of an electric battery. The pieces of rock which are small enough are then selected and loaded into small cars for transportation to the kilns. Such pieces as are too large for the kilns are left to be broken up with sledge hammers before going to the cars, except in quarries where a rock crusher is used, in which case they are loaded for transportation to the crusher.

The process of mining the rock is also used in the Louisville district, though it is usually resorted to only when the great depth of earthy deposit above the cement rock makes stripping unprofitable. The mills are almost evenly divided in number as to the process used, and several plants use both processes.

In the Rosendale district practically all of the rock is mined or tunneled, and not quarried. The mines are generally worked on the slope and the rock is brought to the surface by rope haulage. This process is more expensive than quarrying, but the formation of the rock in this locality necessitates it. As Rosendale cement is the oldest and best known of the natural-rock cements now on the market, it has been successful notwithstanding the expensive mining.

PUZZOLAN OR SLAG CEMENT.

Of names given to the three varieties of hydraulic cement now produced in the United States two, it will be observed, originated in geographical localities.

The name "Portland" was given to his cement by Joseph
of Leeds, England, who in 1824 obtained a patent for a materia
in his specifications is described as Portland cement, because
resemblance in color to the well-known grayish-blue building st
quarried from the peninsula of Portland, on the coast of Dorsetshir
England.

Pozzuolana is the name of a rock possessing the properties of hydraulic lime or cement, found in the vicinity of the village of Pozzuoli, near Naples, Italy, where it was first discovered. It is said to have been used extensively by the Romans in making cements and mortars. As several forms of this word have been used in the business world, doubtless with a view to contracting an unquestionably clumsy name, it seemed proper to secure an expression of some opinion as to the form most commonly used among the manufacturers of slag cement in this country. This was accordingly done in 1904, and as a majority of those whose opinions were requested showed a preference for the name as it is used at the head of this paragraph, i. e., Puzzolan, that form has been adopted for official use in this Bureau.

PRODUCTION.

There were in 1904 but two States which had more than one plant for the production of Puzzolan, or slag cement, and hence it is not yet possible to publish a table giving full details of production in each State. To avoid the disclosure of individual figures, therefore, Alabama and Illinois are combined in the following table to make a total which is set against Alabama, as the two plants in that State gave it the greater production; and Maryland, Ohio, and Pennsylvania are combined, with the resulting total placed against Ohio, since the two plants in that State also gave her the largest production. New Jersey produced no slag cement in 1904.

Below is a table showing total production of slag cement in the United States, together with the number of factories in each State:

Production of slag cement in the United States in 1903 and 1904, by States.

State.	1903.			1904.		
	Number of works.	Quantity.	Value.	Number of works.	Quantity.	Value.
		Barrels.			*Barrels.*	
Alabama	2			2	187,677	$141,402
Illinois	1			1		
Maryland	1			1		
New Jersey	1			1		
Ohio	1			2	115,368	85,249
Pennsylvania	1			1		
Total	7	525,896	$542,502	8	303,045	226,651

THE PUZZOLAN OR SLAG CEMENT INDUSTRY BY STATES.

Detailed accounts of the States which in 1904 contributed to the total quantity of slag cement made in the United States are as follows:

Alabama.—In this State there were two plants operated during the year to produce slag cement. They are owned by separate companies, but for several years past have been managed by one company, that held a lease of the second plant. The total production for the year was not so large as that for the previous year.

Illinois.—Of the three large cement plants now owned and operated by the Illinois Steel Company but one is used to produce slag cement. The other two mills use slag in combination with other materials, grinding and burning them together in crushers and rotary kilns, and thus manufacturing a true Portland cement. The two processes should not be confused. The use of slag and limestone as ingredients for Portland cement makes, when properly treated, a mixture that is chemically correct and meets all the specific requirements for a good Portland cement. In the production of Puzzolan, or slag cement, no burning in rotary kilns is done, and the finished product does not reach the requirements of a true Portland cement. The factory operated in North Chicago by the Illinois Steel Company is the only one producing slag cement in Illinois at the present time. It was operated only about half the year on account of a dull market and produced a much smaller output than that for 1903. The Portland cement plant at South Chicago ran the entire year.

Maryland.—The depression in the cement trade and the extremely low prices which prevailed in 1904 were felt by all producers of cement in the United States, but more especially by those in the Eastern States. Maryland, which produces only natural-rock and slag cements, was not an exception to this rule. The single slag cement plant in the State was active for a time, but its output was not a large one, and the mills of the cement department were closed down for nearly three-quarters of the year.

New Jersey.—No production of slag cement is reported from the plant in this State for 1904, the factory, which is located at Perth Amboy, being idle because of moving its site and of lack of demand.

Ohio.—This State, like Alabama, has now two plants which are engaged in making Puzzolan, or slag cement, as the new plant which was being built in 1903 became an active producer in 1904, despite the fact of its undergoing a somewhat destructive fire. The output of the two factories was creditable, though neither of them ran on full time through the year. Until 1904 Ohio has had but one slag cement mill.

Pennsylvania.—The one plant in Pennsylvania which produces slag cement was active in 1904 through about half of the year, and its production was smaller than that for 1903. There is in this State another plant where slag and limestone are used as ingredients in producing cement. As, however, these raw materials are calcined in rotary kilns and the resulting clinker ground, and as the finished product meets every requirement of a Portland cement, this factory can not be numbered among the slag-cement producers.

VARIETIES IN BLAST-FURNACE SLAG CEMENTS.

In view of the fact that slag is now recognized as being a material of importance to the cement world, the following extract from Mineral Resources for 1887 is here given:[a]

Interest in cement made with blast-furnace slag as one of the ingredients seems to be rapidly gaining ground. The following, taken from London Engineering, is a brief account of some of the processes which involve slag as an ingredient:

"Three kinds of cement are made from blast-furnace slag. The first, which is really more of a mortar than a cement, is produced by grinding slag sand with 15 per cent of lime and 15 per cent of oxide of iron. The grinding is generally done wet and the product requires to be used within a few hours after being made, so that its employment is quite local. The second cement is made by grinding 75 per cent of dry slag sand with 25 per cent of dry slaked lime, according to Mr. Larsen's patent. It is essential that the ingredients should be finely pulverized and that they should be intimately commingled. For this purpose the inventor uses a machine which he calls a 'homogeneizer.' The third cement is made according to a process brought out by Mr. Frederick Ransome. Equal weights of slag, sand, and chalk are ground together in a wet state, and after being dried are burned either in a kiln or revolving furnace, the process followed being similar to that used in making Portland cement. The following table gives analyses of two of the cements we have mentioned and also of two examples of Portland cement:

Analyses of cements.

	Lime.	Silica.	Alumina.	Ferric oxide.	Ferrous oxide.	Magnesia.	Water.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
No. 1 slag cement	22.9	21.01	19.85	8.80	4	4.36	12
No. 2 slag (Larsen)	41.96	24.34	18.74	.14	.27	6.57	4.70
Portland (No. 1)	59.9	24.07	6.92				
Portland (No. 2)	55.57	22.92	8.6				
Middlesbro' slag	40	52.34					
Middlesbro' (No. 2)	36.88	51.12					
Middlesbro' (No. 3)	40.45	50.08					

The first and second analyses are by Mr. J. E. Stead. The nonessential ingredients are not given.

"From this it will be seen that the first two cements are widely different in their chemical constitution from Portland cement, and they are still more different in their physical condition, for the lime is mostly free, the materials not having undergone the incipient fusion which Portland cement experiences. Now, in the slag the proportion of lime to alumina and silica is about as 39:51, while in cement it is as 58:31; therefore 100 parts of slag, including the inert matters, require the addition of 56 parts of lime, or of 100 parts of dry chalk or limestone, to provide the constitu-

[a] Mineral Resources U. S. for 1887, U. S. Geol. Survey, 1888, p. 531.

ents of a good cement, and this is the mixture used in Ransome's process. The result gives a product which exceeds the strength of Portland cement, and which improves with age. Samples 7 years old are in existence, and show no signs of deterioration. Of course, the process is only commercially feasible in districts where slag is produced, but there it offers a means of turning a useless product into a valuable material, and, if it be carried out by Ransome's revolving furnace, the expense for plant is comparatively small."

The reference to "Ransome's revolving furnace" in the foregoing will readily be recognized as indicating the patent process for burning cement first invented by Frederick Ransome, from which the present 60, 80, and 100 foot rotary kilns are an evolution.

In 1904 several new processes dealing with methods for immediately chilling the slag in cold water were exploited. Among them is one for chilling the hot slag in cold milk of lime, thereby increasing the hydraulicity as well as the tensile and compressive strength of the resulting cement. The effort to improve slag cement is constantly being made by those interested in the use of slag as a base for the production of a good cement.

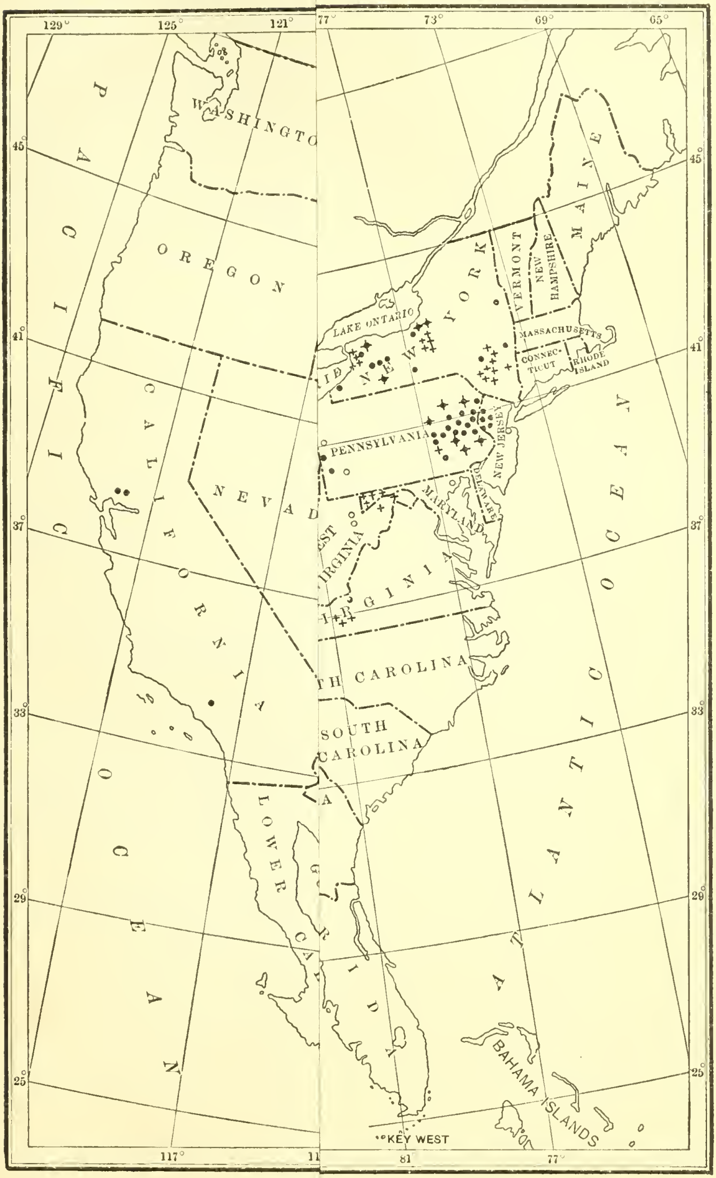
LOCATION OF CEMENT PLANTS.

The map printed herewith (Pl. II) is designed to show the general location of the cement plants in the United States at the present time. The great possibilities of the cement industry in the West, the large territory as yet not supplied with cement mills, and the proximity of plants to each other are seen at a glance. Only such mills as are already built and those so nearly completed as to be practically ready for operation are indicated. There are several plants, like the one in Nebraska and the one in Florida, which have been idle for a number of years. These plants are given place on the map, since they are located on or near well-known deposits of material suitable for use in the manufacture of cement, and are liable to become active producers whenever the companies owning them are reorganized or the demand for cement seems to justify their operation. There are companies reporting to this Bureau plants about to be built, so that within another year the number of mills may be decidedly increased; but these projects are not indicated on the accompanying map.

IMPORTS AND EXPORTS.

IMPORTS.

The total quantity of hydraulic cement imported into the United States for all purposes in 1904 was 1,046,293 barrels. Of this amount 968,410 barrels were entered for consumption in this country. The remaining 77,883 barrels were not consumed here. They may have been entered merely for transportation to some other country via America, or have been left unused in the warehouse, or they may have been sent to the United States for consumption and, upon arrival


PACIFIC OCEAN
WASHINGTON
OREGON
CALIFORNIA
NEVADA
LOWER CALIFORNIA
LAKE ONTARIO
NEW YORK
VERMONT
NEW HAMPSHIRE
MAINE
MASSACHUSETTS
CONNECTICUT
RHODE ISLAND
PENNSYLVANIA
NEW JERSEY
DELAWARE
MARYLAND
VIRGINIA
SOUTH CAROLINA
ATLANTIC OCEAN
BAHAMA ISLANDS
KEY WEST
129°
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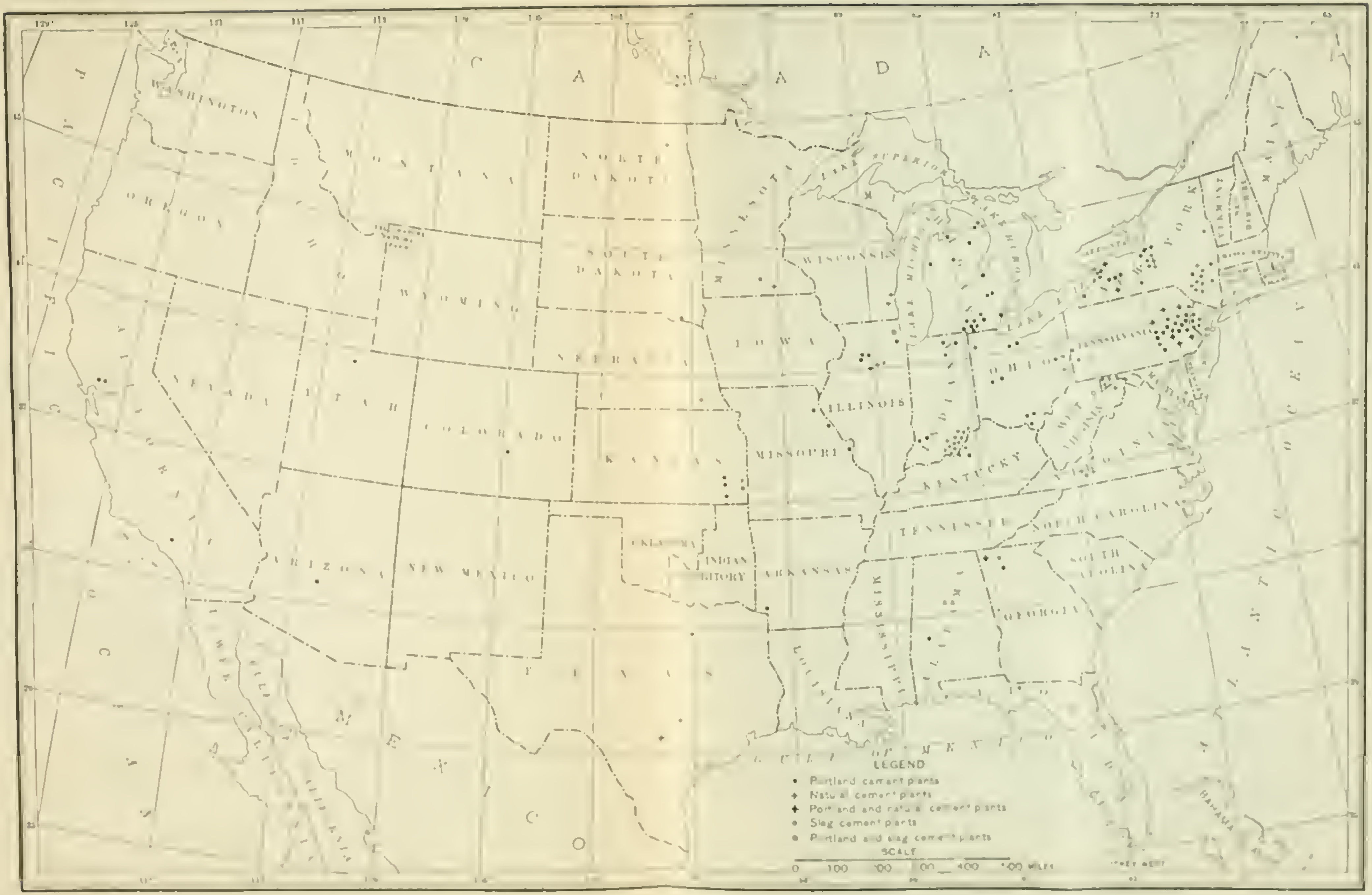

LOCATION OF CEMENT PLANTS.

here, may have been more profitably or more quickly disposed of elsewhere. This explanation is made in order that no misunderstanding as to the figures showing imports which are used in the following tables may arise. In one table total imports of all hydraulic cements brought into this country for any purpose whatever are shown. In another only the imports actually withdrawn from the warehouse for consumption here are shown. In each case barrels of 400 pounds each are indicated.

Following is a table showing imports of all hydraulic cements into the United States, by countries:

Imports of hydraulic cement into the United States in 1900, 1901, 1902, 1903, and 1904, by countries.

Country.	1900.	1901.	1902.	1903.	1904.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
United Kingdom	267,921	37,391	79,087	146,994	16,365
Belgium	826,289	303,181	615,794	737,576	394,368
France	32,710	11,771	14,922	14,866	34,912
Germany	1,155,551	560,596	1,259,265	1,377,414	585,439
Other European countries	75,827	19,078	18,654	27,415	7,538
British North America	4,517	6,066	3,612	4,421	580
Other countries	23,869	6,809	4,154	9,265	7,091
Total	2,386,684	944,892	1,995,488	2,317,951	1,046,293

RELATION OF DOMESTIC PRODUCTION AND CONSUMPTION TO IMPORTS.

In the following table the increase in the total quantity of Portland cement produced in the United States since 1890 is shown, as well as the decreased production of natural-rock cement, and the variations in the imported hydraulic cement consumed in this country since that year:

Comparison of production of Portland and natural-rock cement in the United States with imports of hydraulic cement, 1890–1904.

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
1898	8,418,924	3,692,284	12,111,208	1,152,861
1899	9,868,179	5,652,266	15,520,445	2,083,056
1900	8,383,519	8,482,020	16,865,539	2,321,416
1901	7,084,823	12,711,225	19,796,048	922,426
1902	8,044,305	17,230,644	25,274,949	1,963,023
1903	7,030,271	22,342,973	29,373,244	2,251,969
1904	4,866,331	26,505,881	31,372,212	968,410

In this table the production of Puzzolan or slag cement, which has been recorded elsewhere in the reports on the production of cement for 1901, 1902, and 1903, does not appear. It was as follows: 1901, 272,689 barrels; 1902, 478,555 barrels; 1903, 525,896 barrels, and in 1904, 303,045 barrels.

Following is a table showing a comparative statement of the production of Portland cement in the United States, with the total amount of imported hydraulic cement consumed in the United States in 1891, 1901, 1902, 1903, and 1904:

Comparison of domestic production of Portland cement with consumption of all hydraulic cements, 1891, 1901–1904.

	1891.	1901.	1902.	1903.	1904.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Production in the United States	454,813	12,711,225	17,230,644	22,342,973	26,505,881
Imports (entered for consumption)	2,988,313	922,426	1,961,013	2,251,969	968,409
Total	3,443,126	13,633,651	19,191,657	24,594,942	27,474,290
Exports (domestic)	....	417,625	373,414	285,463	774,940
Total consumption	3,443,126	13,216,026	18,818,243	24,309,479	26,699,350
Percentage of domestic production to total consumption in the United States.	13.2	96.2	91.6	91.9	99.2

EXPORTS.

The matter of exporting cement from this country has not yet received the attention from American manufacturers that it has received in other cement-producing countries. America is the largest consumer of cement in the world, and in view of her increasing facilities for production, a statement of figures for the purpose of showing the quantity of domestic cement that has been exported from the United States during the last five years seems opportune. The figures used in the following table show only domestic exports. The total quantity of hydraulic cement exported in 1904, both domestic and foreign, was 814,551 barrels.

Exports of domestic hydraulic cement, 1900–1904.

Year.	Quantity.	Value.
	Barrels.	
1900	100,400	$225,306
1901	373,934	679,296
1902	340,821	526,471
1903	285,463	433,984
1904	774,940	1,104,086
Total	1,875,558	2,969,143

It is a fact that in case of an overstocked cement market in the United States, much relief might be afforded by the establishment of a substantial foreign trade. The freight rates at the present time are not prohibitive. On this subject Rock Products, in its issue for October, 1904, says:

There has not been any systematic effort made to secure the trade of foreign countries, it having been generally the belief that the American mills could not meet competition with the German cements, due to the alleged fact that the Germans enjoyed much lower ocean freight rates, possibly due to the subsidizing practice of foreign governments.

An investigation on this point proves that this idea is erroneous. American Portland cements, sold at a price which is from 10 to 25 cents per barrel (including export companies' profits) above the price which is now being quoted for domestic shipments, may successfully compete in South America, South Africa, Central America, West Indies, and at equal figures with that being quoted for domestic trade there, and can successfully compete in India, China, and the Philippines.

The freight rate from New York to South Africa is no higher than from Lehigh Valley mills to St. Louis at the present time.

Foreign cements are selling in South America and in South Africa at present, ranging from $3 to $5 per barrel, according to the quality, and right here it would be well to state that investigations carried on by the leading cement experts demonstrate beyond a doubt that there are high-grade Portland cements manufactured in the United States which are superior in every way to the highest grade of Portland cement manufactured in Europe.

The total consumption of hydraulic cement in the United States in 1904 was 31,868,727 barrels.

PRODUCTION OF CEMENT IN CANADA.

The depreciation in prices of Portland cement was evidently felt in Canada as well as in the United States, for while the total production of that article in Canada for 1904 is reported to be 222,617 barrels in advance of the figures showing total production of Portland cement in 1903, the increase in values in 1904 over 1903 is only $107,150. There was in 1904 a further decrease in the production of natural-rock cement, which in 1903 fell behind the production for 1902.

The full figures for Canada's total production of cement in 1904 are 907,172 barrels, valued at $1,247,389. Of this total, 850,358 barrels, having a value of $1,197,992, are Portland cement, and 56,814 barrels, with a value of $49,397, are natural-rock cement. In 1903 Canada produced 627,741 barrels of Portland cement, worth $1,090,842, and 92,252 barrels of natural-rock cement, worth $75,655.

The factories operating to produce Portland cement in Canada in 1904 used marl as raw material to furnish lime for their mixtures; but several new plants are being constructed with a view to the use of limestone. An abundance of this stone is known to exist in Ontario, and its composition has proven satisfactory, under analysis and test, for use in the production of Portland cement.

AVERAGE CHARACTERISTIC TESTS OF CEMENT IN THE UNITED STATES.

Although continued efforts have been and are still being made looking toward the establishing of more convenient and more uniform methods of testing cements, as yet no wholly satisfactory basis has been established. After a number of years of careful research and investigation the committee on uniform methods of tests of cement of the American Society of Civil Engineers have reported a set of rules governing methods of tests, which are the most complete and the best that have thus far been proposed. The gradual and almost universal adoption of these rules has made it possible to obtain far greater uniformity and concordance in results than have hitherto been obtained. But the absence of an absolute basis on which tests could be made with great uniformity should be considered in making a compilation of average results of tests from any set of statements sent in from the various cement mills, and the difficulty of arriving at a more than approximate average of the whole is at once apparent.

It is in response to many requests for a statement as to average characteristic tests of the cement produced from the various materials used in different parts of the United States that the accompanying table has been made.

The impossibility of exactly representing in such a table the quality of the cement manufactured throughout this country will be appreciated by anyone familiar with the compilation of tables showing tests of cement; and therefore this table is not intended to be absolute, but should be regarded simply as an effort to show the relative values and variations of the three classes of cement manufactured in the United States.

The qualities looked for in testing cement are soundness, fineness, uniformity of composition and burning, and strength; and while these are indicated to a large degree by the results of tests, yet there are many things entering into the making of a reliable cement which can only be touched upon in any table of tests in a most casual way. The imperfect preparation of raw materials, or a burning which is incomplete, may yield a product the quality of which is only partially, if at all, indicated in the test for specific gravity, while the cement can be adulterated to a considerable extent before it is disclosed by this test. The adhesive power of cement is very dependent on its fineness, the coarser portions of the powder being practically inert. Hence, the value of the tests for fineness, other things being equal.

The time of setting is stated in minutes in the table used here. The first or initial set of cement takes place when the mixture of water and cement ceases to be plastic; the final or hard set takes place when the mixture has acquired a certain degree of hardness, usually ascertained with the well-known Vicat needle or some modification of it. The quickness with which the mortar is mixed and the dexterity with which the molding is done enter into the question of the ultimate strength attained by the cement, but can not, of course, be in any way brought into a tabulated statement of tests. The average tensile strength of the cement briquet, both neat and mixed with sand, is given in detail in the table as to strength attained in a given number of days. The results of these tests for tensile strength depend somewhat upon the kind of machine used in breaking the briquet, upon the care taken in keeping the clips free from dirt or sand, and upon the care used in placing the briquet in the clip in such a way that the strain will be evenly distributed. None of these things can be tabulated or indicated in a tabular statement, yet they are of importance.

Chemical analyses are made principally to determine what percentages of the different ingredients necessary for the manufacture of Portland cement exist in the mixture under test; also, they are often useful in revealing the presence of adulterants. It is necessary that the proportion of magnesia (MgO) and sulphuric anhydride (So_3) be small, as in excess they are injurious. The percentage of water used in making the paste for pats or balls or briquettes for tests is of importance in many ways and materially affects the results obtained. The quantity of water used in mixing cement makes a difference in the density of the briquette and gives rise to variations in the tensile strength developed. For this reason it would be of interest to publish figures showing a characteristic average of this percentage. It was, however, impracticable to compile such a statement from the data forwarded by the manufacturers, as that point was not specially covered in the requests for data as to average characteristic tests sent out by this Bureau, and in only a few cases was it recorded. Owing to this fact the item has been omitted from this table altogether. There is nothing stated in the table as to the soundness of the cement used for the tests, because all of the tests were made with cement which had perfectly passed the usual tests for constancy of volume, viz, the immersion of pats in cold water, in boiling water, and in steam.

The tests for soundness differ in this country from those used in Germany, where the standard test is made by placing a pat of neat cement in water of a normal temperature for twenty-eight days. The objection to this test is the length of time it requires, and, while the cold-water test is used in the United States, the accelerated tests are more commonly made, as immersion of the pats in steam or boiling water usually reveals in a very short time evidences of unsoundness, if they exist, which would only be developed after a much greater length of time if cold water were used.

A few of the elements entering into cement testing, which can not be put into tabular form, are sufficiently indicated by these comments to give a proper estimate of their value, and to lead to a consideration of them in using the tabulated averages. The figures used in preparing the tabulation have been almost entirely those furnished on request by the producers of cement in the United States. They have been arranged and averaged in accordance with the kind of material used in making cement, limestone and cement rock being the raw materials used in the Lehigh district. The subdivisions shown under "Portland cement" are extremely interesting, in that they seem to indicate that no matter what variety of raw materials are used, provided they contain the requisite ingredients and are properly treated in the process of manufacture, the resulting product will yield practically the same strength tests.

The following table shows average characteristic results of tests of cements in the United States.

Average characteristic tests of cement in the United States.

Class.	Materials used in making cement.	Specific gravity.	Per cent passing through sieve.		Time of setting.		Tensile strength in pounds per square inch.									Chemical analysis.						
							Neat.					1 to 3.										
			No. 100.	No. 200.	Initial.	Hard.	1 day.	7 days.	28 days.	6 months.	12 months.	7 days.	28 days.	6 months.	12 months.	SiO_2.	Al_2O_3.	Fe_2O_3.	$Al_2O_3Fe_2O_3$.	CaO.	MgO.	SO_3.
					Min.	*Min.*																
Portland cement.	Limestone and cement rock	3.14	93.7	75.2	155	392	371	675	750	789	945	239	315	366	442	22.07	7.51	2.50	10.01	62.82	2.58	1.51
	Limestone and clay or shale	3.13	95.0	76.2	172	341	341	696	825	916	919	252	353	401	403	22.18	7.31	3.49	10.80	62.80	1.62	1.39
	Limestone and granulated basic blast furnace slag.	3.10	98.5	(a)	260	500	358	636	790	888	916	226	298	382	396	23.62	8.21	2.71	10.92	61.92	1.78	1.62
	Marl and clay or shale	3.11	94.0	79.2	151	357	328	670	772	780	790	269	352	385	395	22.36	6.93	2.68	9.61	63.37	1.99	1.33
	Average	3.12	95.3	76.9	185	398	350	669	784	843	893	247	330	384	409	22.56	7.49	2.85	10.34	62.73	1.99	1.46
Puzzolan or slag cement.	Slaked lime and granulated basic blast furnace slag.	2.88	99.4	95.0	145	452	120	432	502	651	(a)	189	260	272	(a)	29.55	12.60	0.80	13.40	50.22	2.23	1.36
												1 to 2.										
Natural-rock cement.	Argillaceous limestone	2.87	92.6	79.9	34	144	129	197	289	404	501	143	226	295	368	29.07	10.54	4.08	14.62	39.50	11.77	....

a Omitted for lack of sufficient data.

PRECIOUS STONES.

By George F. Kunz.

INTRODUCTION.

The important facts in the history of precious stones in 1904 are in the main as follows:

The output of diamonds was less in quantity than in 1903, and the year was marked by several advances of 5 per cent in the price of the rough-diamond material, which was imported into the United States to the value of \$9,675,742, from which it would appear that diamonds and pearls to a greater value are now cut annually in the United States than were imported, cut or uncut, into the country for the years 1867 to 1871, inclusive, or for any one year until 1887. The value of the total import of precious stones for the year was \$26,086,813.

The cutting strikes in Amsterdam, which were of long duration and threatened to be so disastrous to the diamond trade, are apparently settled for a period of at least three or four years to come.

The greatest diamond known in history (prior to 1905), the "Excelsior" of Jägersfontein, has been cut up and divided into ten stones, weighing from $13\frac{3}{4}$ to 68 carats each, and furnishing a total of $340\frac{17}{32}$ carats of the whitest material of any of the large diamonds, with a total value of about \$400,000.

No great diamond discoveries abroad were chronicled during 1904, but the development of the mines in the Transvaal has been remarkable, the new Premier having produced diamonds to a total of 749,653 carats, valued at \$4,201,000, during the year, and promising to become a still greater factor in production. In the case of this mine, 60 per cent of the output is controlled by the Transvaal Government.

No discoveries of diamonds were recorded in the United States during the year 1904.

In Brazil a number of attempts were made to form new diamond mining companies, but the output has been very small.

In British Guiana the interest is still maintained, and the production was about the same as in the preceding year.

It is a fact of especial interest that in the cutting of gems other than the diamond many foreign lapidaries have entirely discarded emery (corundum) and are substituting for it the artificial carbon silicide, carborundum, which has a hardness of 9.5, between corundum (9) and diamond (10), and is the best-known abrasive next to the diamond. The year 1904 also witnessed the first discovery of this substance as a natural mineral in the Canyon Diablo meteorite by Prof. Henri Moissan, of Paris, France, and the naming of it after him, *moissanite*, as a true mineral, by the writer.

Australian sapphires, from the Anakie district of New South Wales, which are frequently too dark for high-grade stones, were cut in quantities in both faceted and unfaceted forms and en cabochon and used for the medium quality of jewelry.

In the United States one gem discovery after another has been made in southern California, notably in San Diego County, where there have been found magnificent blue and white topazes, near Ramona, which as crystals quite equal those from Siberia, a single one weighing more than a pound; beryls from 3 to 6 inches in length and 1 or more inches in diameter, pale to dark sea green in color; crystals of rose-colored beryl, until recently one of the rarest varieties of this mineral, at Mesa Grande and Pala (and also at Hemet, in Riverside County); axinite, a gem mineral not previously known in good crystals in this country, though formerly in Switzerland and France, in beautiful crystals, near Bonsall; colored tourmalines, red and green, have been extensively mined at Mesa Grande, Pala, and other localities in the same county; and epidote in crystals only 1 inch in length and one-eighth of an inch in diameter, but transparent, has been found near Hemet, in Riverside County. The old locality at Mount Mica, Paris, Me., has produced fine tourmaline crystals and some good gems; a new locality, also interesting for its crystals of tourmaline, which are large and beautiful, although of little gem value, has been opened near Rumford Falls, Me., and some very fine crystals have been found at the mine at Haddam Neck, Conn. Kunzite, the new gem spodumene, has been mined, but not so extensively. As to sapphires, the entire output and also all previous outputs of those found at Yogo Gulch, Mont., have been disposed of abroad up to the present time by the companies which operate these mines from London. Turquoise has been mined with some success at a number of localities in New Mexico, Arizona, Nevada, and California. The new locality for peridot, olivine, or chrysolite, as it is variously known, at Talklai, Gila County, Ariz., has yielded great quantities of this mineral, immediately associated with or inclosed in the volcanic rocks; thousands of beautiful gems of from 1 to 5 carats have been cut from this material and extensively sold throughout the United States.

Great development has taken place in gem production in Brazil. Continued exploration in the State of Minas Geraes has led to great discoveries of tourmaline, which have furnished magnificent red (rubellites), as well as blue-green, and green gems; and large quantities were found, cut, and sold during 1904. Further discoveries of gem beryls in the same State have furnished magnificent blue and green aquamarines, which have been cut and have reached the gem markets of the world.

In regard to the Brazilian amethyst, a large quantity of gems have come from the great geode, the bulk of which was shown at the Düsseldorf Exposition in 1902. Many of these which were obtained from the points of the myriads of crystals that lined the great grotto were, on account of their rich, dark color, sold as Siberian amethyst.

There has been an extensive demand for many of the semiprecious stones, such as the peridot, of which quantities have been cut from Egyptian material, and the yellow smoky quartz called topaz from Spain and Brazil. The Queensland opal matrix has also been much in favor, both the variety with rich patches of opal, either white or bluish, often of great brilliancy, and the variety that is dark brown, with the entire mass permeated with very thin irregular streaks or veins of highly colored opal, making a perfectly iridescent play of color on a brown field, like the lumachelle marble.

Semiprecious stone beads of every variety of material, in short and long necklaces and of all sizes, either round, India cut, or faceted, made of amethyst, Spanish topaz, rock crystal, rose quartz, aventurine, blue chalcedony, amazon stone, New Zealand jade (nephrite), Burmese (so-called Chinese) jadeite, moonstone, garnet, and other minerals of every kind, have been sold in great profusion.

Coral has been greatly in vogue, especially in the form of beads, often of great size. The market has demanded the richest Mediterranean coral, either deep red or delicate pink; Japanese coral, pink, yellow pink, and red; as well as white coral, either pure white or with a single speck of red or pink on each bead, the beads in the center of a string being often ¾ of an inch to 1 inch in diameter. The demand and the high price for the pale-pink coral has led to some imitations, consisting, first, of a decoloration of the darker coral by heating; second, of marble of about the same weight as coral and stained with aniline or other dyes; third, of white coral stained in the same manner; and, fourth, of glass paste imitations imported from the East. Another imitation is made from the mineral substance so much used by the Chinese for their stone carvings and imitations of jade, agalmatolite or Chinese figure stone, which is very cleverly stained to be palmed off as red or deep-pink coral.

DIAMOND.

UNITED STATES.

INDIANA.

No further diamond occurrences of any importance have been reported lately within the United States. Two or three small stones have been found in Morgan County, Ind., in cleaning up the sluices of a gold-washing plant recently installed about 29 miles from Indianapolis. These facts were communicated to the writer by the State geologist, Prof. W. S. Blatchley, who also mentions the finding of a few sapphires and rubies in the same association, some of which have been cut into small gems for directors of the gold-washing company. For previous references to gold and various minerals, including corundum, in the glacial gravels of this region, see report of this Bureau for 1902, page 814.

Professor Blatchley states that he had learned of an offer of $1,200 having been made for the "Maxwell" diamond, one of the earlier stones from this vicinity and the best that has been yet obtained in the State, the value being mainly a local one, as the gem value only is a small part of the sum.

As to the source or sources of these diamonds, supposed to be drift diamonds transported by ice from Canada, a letter from Dr. H. M. Ami, of the Canadian Geological Survey, states that no diamonds have yet been found within Dominion territory, although much interest has been awakened by the discussion of the subject in the public press, and many persons have been on the lookout for occurrences.

The new National Transcontinental Railway, from Quebec to Winnipeg and the great wheat region of Manitoba, will traverse much of the country whence the drift diamonds have probably come, and Doctor Ami states that the Government is sending out numerous survey parties for exploration along the route. Some of these may make interesting and even important discoveries.

CALIFORNIA.

With regard to diamonds in California, it seems as though the extensive dredging operations now being conducted upon the gold-bearing gravels of that State should bring to light many diamonds, though none have as yet been reported. By this process large areas of auriferous gravel are being exploited on a great scale, the whole deposit down to bed rock being taken out and washed. The process is described in all its aspects and at all the localities in a recent bulletin (No. 36) of the State Mining Bureau of California,[a] a publication

[a] Gold dredging in California, Bull. No. 36, California State Mining Bureau, 1905.

of much interest and value. The dredging process is applicable only to certain portions of the auriferous gravel beds of the State—those which are not much compacted, are not saturated with water, and rest upon a soft bed rock of ash or tufa. Of such deposits there are estimated to be some 2,500 acres in several of the counties in the Sacramento Valley, especially in Butte, Sacramento, and Yuba counties, and there are some deposits in the northern portion of the State. These gravels vary from 25 to 60 feet in thickness, with a mean of about 35 feet, and carry gold, and occasionally platinum, etc., to an average value of some 18 cents per cubic yard.

SOUTH AFRICA.

De Beers consolidated mines.—The sixteenth report of the general manager, Mr. Gardner F. Williams, brings the record of operations down to the close of the company's year on June 30, 1904. In comparison with the report for 1903, reviewed in the last report of this Bureau,[a] the most salient points are the extensive developments in progress at the great Dutoitspan mine, the enormous quantities of blue ground in sight at this and the Bultfontein and the Premier mines, and the fact of a continued falling off in the richness of the blue ground in the De Beers and the Kimberley mines. This latter has now become such as to exceed the counteracting advance in the price of diamonds, so that the value per load extracted has begun to decline.

In general the supply of negro labor has been adequate to the needs, though liable to fluctuation from the desire of the natives to go to their homes at planting time and at harvest. The number employed has varied from a little below 10,000 to 13,750. A large amount of development work and construction has been done at all the mines, and great expense has been incurred in the installment of machinery, insomuch that little will be necessary for this purpose for some time to come. Illicit diamond buyers have been active during the year, and a number have been caught and sentenced.

An interesting point is made as to the timber for the mines. For this purpose California redwood (*Sequoia sempervirens*) is found to be the best. Redwood sleepers after ten years in the ground proved to be as sound as at first, while Oregon pine, Puget Sound cedar, African yellow wood, and Baltic deals had decayed and had been replaced.

Large quantities of tailings have been washed during the last three years with good results, and Mr. Williams claims that the company possesses "an enormous asset" in these accumulations of years, which are now being steadily washed and reduced.

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[a] Mineral Resources U. S. for 1903, U. S. Geol. Survey, 1904, pp. 911-917.

Total production of Kimberley diamond mines since the consolidation of the De Beers Company in 1889, by mines.

	De Beers and Kimberley (15 years).	Premier (7 years).	Bultfontein (4 years).	Total.
Loads of blue hoisted	38,843,766	11,842,360	1,249,267	51,935,393
Loads of blue washed	37,304,527	10,486,100	851,764	48,642,291
Carats of diamonds found	30,940,461	3,075,850	229,343	34,245,654
Value of the same	£48,461,973 12s. 9d.	£4,600,792 8s. 7d.	£344,777 8s. 0d.	£53,407,543 9s. 4d.

Averages of yield, value, and cost for the same periods, by mines.

	De Beers and Kimberley (15 years).	Premier (7 years).	Bultfontein (4 years).
Yield of carats per load	0.832$\frac{3}{5}$	0.292	0.2466
Value per carat	33s. 0.6d.	28s. 4.5d.	33s. 11.6d.
Value per load	26s. 8.8d.	8s. 3.7d.	7s. 6.97d.
Cost per load	7s. 4.4d.	2s. 11.9d.	6s. 0.4d.

From these figures it appears that these mines, since the year 1889, have produced an initial value in the world's commerce of over \$250,000,000; and that the cost of selling the rough diamonds, and of cutting and polishing, and the new advance in the price of diamonds being added, this initial value represents fully \$600,000,000 to \$700,000,000 by the time the jewels reach the wearers.

Transvaal mines.—An account was given in the last report[a] of this Bureau of the great new Premier mine in the Pretoria district of the Transvaal. Two articles have recently appeared in the Engineering and Mining Journal relating to this mine, one by Mr. C. A. Troge[b] and the other by Mr. T. Lane Carter,[c] whose description of the Vaal River diamond workings was also reviewed in the last report.[d] These articles fully confirm the remarkable accounts before published as to the extent of this great mine, which covers an area of over 70 acres, and they describe the progress in equipment and development during 1904.

The mine lies about 21 miles east of Pretoria, 6 or 7 miles from a small station, Van der Merwe, on the railroad to Delagoa Bay. Access to it thus far has been only by team over a rough country, but a branch is soon to be built from the railroad which will greatly reduce the cost of supplies and fuel.

Premier (Transvaal).—The annual report of this great new mine was presented to the shareholders at Johannesburg on January 3, 1905. It is only the second report, but it shows the extraordinary development of this mine within the short time in which it has been operated.

[a] Mineral Resources U. S. for 1903, U. S. Geol. Survey, 1904, pp. 917–918.
[b] Eng. and Min. Jour., July 28, 1904.
[c] Ibid., Aug. 25, 1904.
[d] Mineral Resources, loc. cit. pp. 918–919.

Production of Transvaal Premier mine for years ending October 31, 1903 and 1904.

	1903.	1904.
Loads of blue washed	76,931	939,265
Carats of diamonds found[a]	99,208	749,653
Value of diamonds found[a]	£137,435 2s. 9d.	£866,030 0s. 5d.
Number carats per load	1.29	0.798
Value per carat[a]	£1 7s. 9d.	£1 3s. 1d.
Value per load[a]	£1 15s. 8d.	18s. 5d.
Cost of production per load[a]	4s. 7d.	2s. 6d.

[a] Fractions of carats and pence omitted.

Since the presentation of the report, two immense diamonds have been obtained at this mine, one the unprecedented stone of 3,024½ carats, of oval form and measuring 4½ by 2½ by 1½ inches, found on January 27, 1905, and the other of 334 carats, found on February 15, 1905.

Vaal River mines.—In the last report of this Bureau there was a review of an article by Mr. T. Lane Carter on diamond gravels and pipes in the Vaal River district.[a] Another and somewhat different article was read before the Institute of Mining and Metallurgy by Mr. F. Ernest Coe.[b]

The region treated of in this paper lies on both sides of the valley of the Vaal, northeast from Kimberley, the portion on the left bank being in Cape Colony and that on the right bank partly in Cape Colony and partly in the Transvaal. Mr. Coe gives a particular account of the mining in the deep placers, or the old river and stream gravels. These represent a period of great erosion, when deep and steep channels were worn through hard diabase rock, and were subsequently filled with sand, pebbles, and bowlders, much rolled and smooth, and then, in some cases at least, were overlain with beds of red sand—the rooi-grond (red ground) of the early Dutch diamond seekers. The floor or bed rock of these deep placers consists of carbonaceous (Karoo) shale, underlain by amygdaloidal diabase. The exact relations of these beds to the period of erosion are not very clear from the account as given, although Mr. Coe goes into considerable geological discussion.

The diamonds are found among the pebbles and bowlders of the deposit filling the channels, and are derived presumably from pipes not yet discovered, save partly, no doubt, from the pipe described by Mr. Carter.

Jägersfontein mines.—Occasional references have been made in former reports to the mining of diamonds at Jägersfontein, in the Orange Free State, now the Orange River Colony. The Jägersfontein

[a] Carter, T. Lane, The Diamond District of the Vaal River: Eng. and Min. Jour., Sept. 5, 1903.
[b] Min. Jour., R'way and Com. Gaz., Aug. 6, 1904, p. 136.

mine has been noted not so much for its great production as for the fact that it has yielded an unusual proportion of large diamonds, among them especially the extraordinary stone found in 1893, weighing 971¾ carats, and named the Excelsior diamond, the largest ever known up to that time.[a]

Production of the new Jägersfontein mine for the year ending March 31, 1904.

Loads of blue hauled	2,076,408
Loads of blue washed	1,836,634
Carats of diamonds found	167,597¾
Value of diamonds sold	£555,695 16s. 7d.
Number of carats per load	.0968
Value per carat	66s. 3.75d.
Cost of production per load	2s. 10.79d.
Loads remaining on floors	975,185

Cape Colony Mines.—One or two new diamond mines are now being developed in Cape Colony, in the district of Griqualand West, and considerable interest is taken at Bloemfontein in the success of this venture. The New Kimberley Diamond Developing Company has been formed to acquire full control of two farms, the Witpan and the Bultpan, situated about 15 miles north of Kimberley and 7 miles east of the Vaal River, on the railroad line to Rhodesia. Mr. F. W. Robb, a Kimberley expert, has made a report to the company upon the Phoenix mine on the Witpan farm, and advises careful and extended development. He describes the work of former prospectors who had made openings here—perhaps 100 claims—in a small pipe to a depth of 30 feet. Recent shafts have gone down 60 feet and 80 feet, all in "yellow ground," after passing through a few feet of capping. Blue ground has not yet been reached, but the yellow ground contains a good deal of olivine, garnet (pyrope), and carbon, and some diamonds, though no recent figures were obtained. Mr. Robb states that the detective department at Kimberley has registered 77 diamonds from this prospect weighing 37½ carats. From this it would appear that the stones thus far found are quite small.

Rhodesia mines.—The diamond-bearing pipes and the surface deposits derived from them apparently occur throughout a wide area of country in South Africa; but the few very large mines already in operation so control and overshadow newer enterprises that there is not much encouragement for further exploration. The Kimberley mines, in Cape Colony, the Jägersfontein, in the Orange River Colony, and the new Premier, in the Transvaal, have the field of African diamond production well occupied. Diamonds are known to occur farther north in Rhodesia, but recent accounts indicate that little is likely in the way of discovery until there is more freedom for individual activity and more promise of returns therefrom. In the report

[a] Sixteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1895, p. 598.

of the Rhodesia Chamber of Mines for September, 1904, this subject is spoken of quite frankly. An agreement exists between the De Beers Consolidated Corporation and the British South African Company with regard to diamond prospecting in Rhodesia that would leave very little for the discoverer of a mine in case the agreement receives legislative sanction. The chamber of mines protests earnestly against such action as discouraging and well nigh prohibitive unless various points are modified and limited and various rights secured, as is the case with gold discoveries under the mines and mineral ordinance of 1903.

BRAZIL.

One or two important articles have appeared during 1904 upon the diamond region of Bagagem and Agua Suja, Brazil. The diamond industry of the State of Minas Geraes was described in 1899 by Mr. T. C. Dawson, of the American legation to Brazil, and his important account was given in abstract in the report of this Bureau for that year. The Bagagem locality is referred to in that article as one long known and worked, but much of the region around it has been but little explored. Agua Suja is about 16 miles distant. An extended article on this locality, by L. F. Gonzaga de Campos, E. M., has been published in the Brazilian Mining Review and the (London) Mining Journal.[a]

BRITISH GUIANA.

The diamond industry developed since 1900 in British Guiana has extended and become established. The fact is now recognized that the first stages of exploitation are fast passing, and that more systematic methods on a larger scale must soon be adopted. A detailed review of the whole subject appeared in the (London) Mining Journal for May 28, 1904, in which the history, the present condition, and the future needs and prospects are quite fully treated.[b]

DUTCH GUIANA.

The occurrence of diamonds in Dutch Guiana has been noted within the last year, the French consul-general at Amsterdam having called attention to the discovery and to the fact of some stones having been sent to Holland and found to be of excellent quality. This announcement was followed by a letter[c] from Mr. Charles Douglas, of Paramaribo, who gave many particulars. The locality is in the Mindreneti district, in central Dutch Guiana, between the Surinam and the Saramaca rivers, and accessible from either.

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[a] Min. Jour., Rwy. and Com. Gazette, July 9, 1904, pp. 23, 30.

[b] Min. Jour., R'way and Com. Gazette, May 28, 1904.

[c] Min. Jour., Rwy. and Com. Gazette, Aug. 20, 1904; ibid., Dec. 8, 1904.

CORUNDUM GEMS.

CORUNDUM.

TASMANIA.

Corundum, occurring in the quartz wash with topaz, zircon, and pleonaste as water-worn nodules and irregular crystals, is fairly abundant at the northeastern tin fields.

SAPPHIRE.

MONTANA.

During 1904 no extensive stoping has been done by the New Mine Sapphire Syndicate in Montana, which has been occupied rather in driving levels. This fact, in addition to the necessity of working through a small break in the lead containing much hard rock at times, explains the reason of a decrease from the production of former years. The price, however, of all qualities has increased during the last year, and any deficiency in output has thus been compensated. The demand for the stones steadily increases, and difficulty has been experienced in filling orders with promptitude.

The product of the mine for the year 1904 is given as follows: Stones for cutting purposes, 38,529 carats; stones for watch-jeweling purposes, 808,404 carats. These are valued, respectively, at $30,170 and $11,570, a total value for the year's output of $41,740.

QUEENSLAND.

The sapphire deposits of the Anakie district in Queensland, which were described in the report of this Bureau for 1902, have been largely developed within the last two years. An extended report upon them, by Mr. Lionel C. Ball, assistant government geologist, has recently appeared, which contains descriptions of all the workings in the several centers of mining activity and many data as to production and value, up to the close of 1904.[a] At that time about 200 men were at work, of whom one-third were at points on Retreat Creek (Sapphiretown, 50, and Middle Camp, 20) and half as many (36) on Policeman Creek, while the remainder were scattered, a few each, at a number of minor workings.

TASMANIA.

Sapphire is quite plentiful at some of the mines. In color it varies to a great extent, being found in almost all shades of blue, dull green, purple, and yellow, and from translucent to opaque. Occasionally it

[a] Ball, Lionel C., The Sapphire Fields of Central Queensland: Queensland Gov't Min. Jour., March 15, 1905, pp. 112–117, with illustrations.

is particolored, with shades of blue to yellowish and colorless. The asteriated variety also occurs. Really fine gem sapphire is scarce; but some very good stones have been cut and polished, although too rare to constitute an article of trade. The ruby has not been obtained. Notable localities are Mount Cameron, Thomas Plain, Weld River, Main Creek, and Branxholm. At Shekleton on the northwest coast fragments of fairly good color to colorless have been collected, associated with zircon and quartz.

RUBY.

BURMA.

The English company, known as the Burma Ruby Mines (Limited), which has been carrying on the exploitation of rubies in the celebrated Mogok Valley in Burma, has continued its operations during the past year, as now for several years previous, with good success.

EMERALD.

NEW SOUTH WALES.

Beryl of gem quality, some of it so richly colored as to be called emerald, has been known for as much as fifteen years past in New South Wales, and numerous gems have been cut therefrom. It occurs in pegmatite, with topaz, fluorspar, and cassiterite, at Glen Creek, 7 miles north by east from Emmaville. Several crystals are described and one very elegant one figured by Mr. C. Anderson in the Records of the Australian Museum in December, 1904.[a]

BERYL AND CHRYSOBERYL.

NEW HAMPSHIRE.

Some good gem material has been recently obtained at the old beryl locality near Grafton, N. H. The exact locality is in Springfield, Sullivan County, 119 miles from Boston and about 4 miles from the Boston and Maine Railroad. About two-thirds of the way up the mountain at this point the Sullivan County Mica Mining Company have operated a vein of mica about 25 feet distant from the vein carrying beryls, which the company did not observe or work. Little has been done yet in beryl mining, only some surface work; but there is described a remarkable development of crystals of beryl and of garnet in a space 14 feet square and 2 or 3 feet deep. A number of fine beryls that yield material for cutting have been taken out.

[a] Anderson, C., Mineralogical Notes, No. 1: Rec. Austral. Museum, vol. 5, pt. 5, December, 1904, p. 301.

UTAH.

Three crystals of beryl have been received from Mr. Maynard Bixby, of Salt Lake City, which because of their color—a rich raspberry red—deserve special notice. The specimens are single crystals, of short prismatic or almost tabular form, 3 millimeters in height and up to 7 millimeters across the basal plane, implanted on imperfect topaz crystals. According to Dr. W. F. Hillebrand and Mr. W. T. Schaller, the only other forms are those of prisms of the first and second order, the habit being the usual one for beryl; the specific gravity is 2.65. The color is presumably due to manganese, of which the crystals contain a very appreciable amount. Approximate chemical determinations leave no doubt as to the identity of the species. The locality of occurrence is that made known by the discovery of bixbyite about 35 miles southwest from Simpson Springs, Utah, in the Dugway Range.

TASMANIA.

A very interesting discovery has been made of chrysoberyl of the rare alexandrite variety in Tasmania. It is found in the tin-bearing drift in the valley of the Weld River, which drains a granite range in the northeastern part of the island. A personal communication from the government geologist, Mr. W. H. Twelvetrees, gives the following statement:

> The tin and chrysoberyl are derived from a biotite-granite, usually with large pseudo-porphyritic crystals of orthoclase scattered through it; but wherever it is stanniferous the biotite has been replaced by muscovite or lithia mica. The age of the granite is considered to be Devonian. One gem was found which has been cut; * * * it is a half inch across, pale in color, but very near the variety * * * found in Ceylon. Several smaller fragments have been obtained. * * * The larger specimen had some semblance of crystallization; the smaller ones are rolled fragments, with no crystallization, and of no value as gems.

Mr. Twelvetrees thinks that the mineral may exist in some abundance, but that it has been overlooked. The cut stone has an attractive light-green color and is red by transmitted light. The piece was found in the ordinary process of treating the drift for tin ore.

TOPAZ.

TASMANIA.

Tasmania is noted for its remarkably fine water-clear topaz, which is often cut and polished for ornamental purposes. It also occurs in pale shades of sea green and blue, but the yellow variety is unknown. It is comparatively abundant throughout the northeastern tin fields, and is sometimes obtained in well-developed crystals of unusually large size for the species. Well known localities are Mount Cameron, Weld River, Thomas Plains, Moorina, and in fact it occurs throughout the whole district in more or less abundance wherever alluvial tin mining is in operation. It is found with quartz, zircon, pleonaste, and occasionally beryl. At Killicrankie Bay, Flinders Island, it is in considerable quantity, and sometimes in large sized crystals. At this locality it has been obtained in place in a pegmatite dike composed of enormous crystals of orthoclase, with quartz and muscovite. At Bell Mount, in the Middlesex district, this mineral is often met with in place in a tin-bearing rock at the junction of granite and Silurian slate. At the Stanley River it occurs in granitic detritus with tin and monazite. Much of the stanniferous rock at Mount Bischoff is topaz porphyry, and the radiating cylindrical variety, pycnite, is somewhat abundant in special portions of this celebrated tin mine.

NEW SOUTH WALES.

Topaz from New South Wales has been recognized and described before; but in a recent paper quite detailed accounts have been given by Mr. C. Anderson, in the Records of the Australian Museum, December, 1904.[a]

ZIRCON.

TASMANIA.

This mineral is extremely abundant at the northeastern alluvial tin mines, but has not been found in place. It occurs as more or less water-worn particles, which rarely exceed 1 inch in length, and the crystallographic characters are usually obliterated. The common forms are the yellow-brown jargon and the bright-red hyacinth varieties. The former is usually much clouded by darker tints, but when cut and polished it becomes a gem of remarkable attractiveness. The hyacinth variety is sometimes of very good color, and is then a beautiful stone.

GARNET.

ALMANDITE.

NEW YORK.

Garnet of this variety occurs largely in the Adirondack region of New York, and, though not of gem quality, is mined quite extensively as an abrasive. A recently issued bulletin of the New York State Museum[b] describes this industry and gives the figures of production; for 1904 these were 3,045 short tons, valued at $104,325, about the same figures as for 1903. The garnet occurs "associated with hornblende-feldspar rocks in crystals that range from small size up to

[a] Anderson, C.: Mineralogical Notes, No. 1; Rec. Austral. Museum, vol. 5, pt. 5, December, 1904; pp. 296–300, and plate 39.

[b] Newland, D. H.: The mining and quarry industry of N. Y. State, N. Y. State Museum Bull. No. 93, Albany, 1905.

masses of several feet across;" the proportions vary widely, and only the richest rock is worked, which is done by crushing and washing. The quarries are situated in the Hudson River Valley near the boundaries of Essex and Warren counties, the principal shipping point being the town of North Creek. Several companies are at work.

TOURMALINE.

CONNECTICUT AND MAINE.

The recent remarkable discoveries of colored tourmaline in southern California have somewhat eclipsed the old New England localities, but within the last year some very fine gem material has again been taken out both in Connecticut and Maine. The resemblances between these remote regions, both in the character and in the association of the minerals found, are very remarkable. Lithia minerals of various kinds, notably the gem tourmalines, occur in almost identical ways in veins or dikes of pegmatite in San Diego and Riverside counties, Cal., as at Haddam Neck, Conn., and in Oxford County, Me., although separated by the entire breadth of the continent and with scarcely any occurrences in all the intervening area.

AUSTRALIA.

Tourmaline of gem quality has been recently announced from Kangaroo Island, South Australia. The government geologist, Mr. H. Y. L. Brown, states that the crystals are very large and fine and yield beautiful gems. They are usually green, and some have also the pink center so often seen in Brazilian tourmalines. Six specimens have been described and figured in the records of the Australian Museum, for December, 1904, by Mr. C. Anderson;[a] these crystals were from the Mining and Geological Museum at Sydney.

JADEITE AND CHLOROMELANITE.

GUATEMALA.

Dr. Max Bauer, of the University of Marburg, has described a number of prehistoric objects from Guatemala made from jadeite and chloromelanite.[b]

QUARTZ.

THERMOELECTRIC PROPERTIES OF QUARTZ.

The thermoelectric properties of quartz crystals have furnished a field of fascinating research in molecular physics which now affords renewed interest in its relation to radio-activity. Sections of smoky quartz, decolorized by heating, regained their color by ten days of

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[a] Anderson, C., Mineralogical Notes, No. 1; Rec. Austral. Museum, vol. 5, pt. 5, December, 1904, pp. 302-303.

[b] Centralbl. neues Jahrbuch für Mineral., 1904, pp. 65-79.

exposure to radium rays. On warming and sprinkling them with flour of sulphur and red lead (the sulphur clinging to the electropositive and the red lead to the electronegative parts of the quartz twin) the smoky tint was developed in three triangles (segments of one of the twins), which were found to be negatively electrified. This study has been described by M. Egeroff.[a] A related question of equal interest concerns the nature of the smokiness that is thus eliminated and redeveloped. It has usually been supposed to be carbon, but it may prove to be something quite different, as it is not easy to see how a carbon compound could thus be affected.

NONCRYSTALLINE QUARTZ.

CHALCEDONY.

A number of occurrences of beautiful varieties of chalcedonic quartz minerals have recently been reported to the writer. Most of these are on the Pacific coast, but several are in other parts of the country.

IOWA.

A beautiful gray and fawn-colored translucent chalcedony, in rolled botryoidal masses, up to 3 inches by 2 by 2 in size, has been found in the vicinity of Ames, Iowa, by Mr. H. B. Jones. These pieces are rich in color, very compact, and would answer for some forms of ornamental work.

OREGON.

Sapphirine chalcedony.—In the vicinity of Eaglepoint, Jackson County, Oreg., a great quantity of beautiful chalcedony, agate, and jasper has been found. Among these are some beautiful white chalcedony, gray, brown, and green jasper, and an endless variety of agate. Of especial interest, however, is a beautiful blue chalcedony (sapphirine), which is quite equal to that found in Hungary or in California.

NEVADA.

Rose chalcedony.—A most beautiful rose and lilac-tinted variety of chalcedony is reported from Aurora, Nev., by Mr. Maynard Bixby, the well-known mineralogist of Salt Lake City, Utah. It occurs in an amygdaloidal rock, and the delicate rose-pink variety, very translucent, rests directly upon a base of almost white chalcedony. Where broken across, the fractured surface shows a peculiar almost stellated structure.

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[a] Comptes Rendus Acad. Sci., Paris, 1905.

JASPER AGATE AND JASP OPAL.

MEXICO.

On the Rancho Guadalupe, a few miles from Ensenada, in Lower California, Mexico, belonging to Mr. T. Morris Flower, there have been found in great quantity—scattered over the surface in the form of bowlders measuring from a few inches across to several feet—jasper, red, with a faint salmon tint, beautiful compact jasper agate, and jasp opal, in color generally red, although frequently turning to green and white, all of which would admit of a very high polish and would be of value in the arts and for certain forms of jewelry. The bowlders have an outer coating of white and cream-colored jasper, but when they are broken the color within is found to be red or yellow or green.

OPAL.

IDAHO.

About ten years ago considerable interest was aroused as to the occurrence of precious opal at several points in Idaho, especially near Moscow, Owyhee County, as noted in the reports of this Bureau for 1892 and 1893. Not much has been done here for some time past, but it is now announced that the Moscow locality has been reopened and is to be worked for opaline or opal matrix.

OREGON.

A deposit of opal in a rhyolite rock exists in Baker County, Oreg., some of which is very handsome, although it does not appear to have been worked commercially. Remarkable specimens were obtained a few years ago by Prof. William B. Dwight, of Vassar College, Poughkeepsie, N. Y., and are now in the cabinet of that institution. One of these is a large mass of rhyolite, containing nodules of precious opal, 1 or 2 inches in diameter, transparent and glassy, and of brilliant colors. In other specimens the opal varies to a peculiar dense white, like the purest white enamel, and again to a transparent hair brown.

NEW SOUTH WALES.

A new opal field is reported in New South Wales, at Wallangulla, near the Queensland border, about 50 miles north from the town of Walgett. Pieces of opal have been picked up in the vicinity for several years past, but no mining had been undertaken until about two years ago, when a syndicate was formed, and careful prospecting revealed the mineral in place (see reports of this Bureau for 1896, 1898, 1900, and 1902). No specific data are yet given as to production, though several hundred pounds' worth are said to have been sent from the new workings by individual miners.

QUEENSLAND.

The opal production in Queensland, described in the report of this Bureau for 1902, has become an important and established industry; though according to official figures it is not as large as it was a few year ago. Other accounts state that it has greatly increased in recent years.

WEST AUSTRALIA.

Crocidolite opal.—The crocidolite opal referred to in the report of this Bureau for 1903, has been analyzed and shown to be, as supposed, a replacement of crocidolite by hydrous silica, with some ferric oxide.

TURQUOISE.

NEW JERSEY.

Turquoise was obtained some months ago at Somerville, N. J., in the workings of the American Copper Mining Company on Watchung Mountain. The specimens were obtained from Mr. Josiah Bond, now of Wichita, Kans., who was at the time the manager of the mine, and who had a number of pieces, some of them as large as a silver dollar and two or three times as thick. They were found in little veins on the incline shaft, about 1,100 feet from the opening. This occurrence is not likely to be of any commercial importance, but it is highly interesting and worthy of record as the most eastern locality for this interesting gem.

NEW MEXICO.

In the reports of this Bureau for a number of years, notes have been given as to turquoise development in New Mexico and the discovery of new localities. In connection with the St. Louis Exposition, a general sketch has appeared as to the history, geology, and present condition of all the mines now actually yielding turquoise in the Territory, by Mr. Fayette Alexander Jones.[a] The account is popularly written and contains interesting facts.

Turquoise is now profitably mined in four different districts of New Mexico. Taken in the order of their modern discovery, these localities are: In the vicinity of Los Cerrillos, north of the Southern Pacific Railway, in Santa Fe County; in the Burro Mountains, southwest of Silver City, in Grant County; at Old Hachita, also in Grant County, and in the Jarilla Mountains, Otero County.

EGYPT.

Prof. Flinders Petrie, the noted archæologist, has recently visited the ancient turquoise mines at Maghara, in the Sinai district. It has

[a] Jones, F. A., New Mexico Mines and Minerals, 1904, World's Fair Edition: Scientific Publishing Company, 1904, New York, pp. 269, 273–277.

been a question whether the mining here was for turquoise or copper, but Mr. Petrie finds indications that both were sought, though perhaps at different periods. Evidences are found of copper smelting in the fourth and twelfth dynasties; but the mines generally seem to follow the veins of turquoise, and the rubbish heaps abound in turquoise chips. Three kinds of mining also are noted. In the third and twelfth dynasties all the work was done with chisels; at another period, not determined, holes were picked in the rock, 5 inches apart and a foot deep, and blocks were then broken out. Neither of these kinds of workings show any traces of flints. Another class of waste heaps contain numerous flints, and may be of Bedawi origin at many periods and even prehistoric.

WEST AUSTRALIA.

Reports have been published of a turquoise mine in the Murchison district, West Australia. The government geologist, Mr. A. G. Maitland, in his report for 1903, states that he has examined several specimens of the supposed turquoise and found them in every case to be richly colored chrysocolla, and not turquoise at all.

MALACHITE AND AZURITE.

ARIZONA.

The malachite and azurite which have been so noted for their beauty as specimens from the mines at Morenci, Ariz., are no longer found to the same extent that they were a few years ago and may become rare hereafter. Such is the statement of Mr. Waldemar Lindgren, of the United States Geological Survey, in a letter to the writer in December, 1904. The magnificent specimens of these minerals obtained several years ago came chiefly from two of the mines, the Detroit and the Manganese Blue; but these have been practically worked out, and no large masses are now found. Mr. Lindgren doubts whether any more such masses are likely to be met with, unless perhaps at some points in the Shannon mine.

An important paper on the copper minerals of this region was published by Mr. Lindgren in the Transactions of the American Institute of Mining Engineers for 1904.[a] In this article the geological conditions and the successive phases of metamorphic action connected with these remarkable deposits are treated of at some length and with considerable detail, and the history of the formation of the various minerals, including malachite, is traced out in a highly interesting manner.

[a] Lindgren, Waldemar: The Genesis of the Copper Deposits of Clifton-Morenci, Arizona; Trans. Amer. Inst. Min. Eng., Lake Superior meeting, Sept., 1904, vol. 35, 1905, pp. 511–550.

PERIDOT.

ARIZONA.

Peridot (olivine) has heretofore been found scattered abroad on the surface in the Navaho country, associated with the pale and ruby-red garnets. During 1904, however, a locality was discovered near Talklai, Ariz., where it is found independently of any garnet occurrence. The specimens are of fine color and often of considerable size. A single peridot came to the writer's notice which weighed 1½ ounces and was 1½ inches in length. The stones are found principally in a peridotite rock, associated with obsidian, in a canyon known as Peridot Canyon. They are also obtained at Mesa, 6 miles from Talklai. The former is the most promising locality in the United States, as the gem here occurs in its natural matrix. The rock is at times porous, like a vesicular lava, and it is from the breaking down of this rock and the weathering out of the included harder peridots that the latter are obtained.

OBSIDIAN.

OREGON.

In the vicinity of Drewsey, Oreg., Mr. E. L. Beede reports finding the mottled brown and black obsidian (marekanite) in pieces more than 1 foot across, similar to that found in the State of Guadalajara, Mexico.

IOLITE.

NORTH DAKOT

Iolite (dichroite) has been found in grains 5 millimeters square, both translucent and transparent, blue in one direction and almost colorless in the other, associated with almandite garnets 3 millimeters across, in a black micaceous quartzose schist, near Edgeley, N. Dak., by Mr. George H. Quivey. This mineral, when clear and of rich color, has been sometimes employed as a gem, and this discovery may prove to be valuable if specimens of fine quality are at all abundant.

UTAHLITE.

UTAH.

Utahlite (compact variscite) was first described and named in the report of this Bureau for 1894. Some recent data have been received regarding it under the name of chlorutahlite. The account given in this communication is essentially identical with that in the report above mentioned, although somewhat more detailed. The locality is in Clay Canyon, Camp Floyd mining district, Utah County, Utah, about 2 miles south of the famous Mercur gold mine, and at an altitude of 6,250 feet. It is on a ridge or spur, one of a number that radiate from the Oquirrh

Mountains, and the spot is quite accessible. The rock is a metamorphosed limestone, at times highly ferruginous and siliceous. The utahlite occurs in a vein 12 feet wide, running with the strike of the country rock, and containing about 10 per cent of limonite.

SERPENTINE.

GREECE.

Mr. W. Brindley, F. G. S., has made a communication to the Royal Institute of British Architects, recently published in their Proceedings, concerning the verde antico marble so much used and valued in Rome and Byzantium. He gives interesting accounts of his search through several years for the lost source of this very elegant and highly prized stone, a quest in which he at last succeeded by the discovery of no less than ten adjacent quarries. These are situated at Casambala, 7 miles northeast of Larissa, near the road leading to the celebrated Vale of Tempe. A neighboring village still bears the name of Marmariani, no doubt the ancient marble-workers' town.

AMBER.

NEW YORK.

A very interesting discovery of Cretaceous amber was made by Dr. Arthur Hollick, of the New York Botanical Garden, in November, 1904, at Kreischerville, Staten Island (borough of Richmond, New York City), where it exists in some abundance. Cretaceous amber is somewhat rare, and this occurrence is of much interest. Kreischerville is situated on the shore of Staten Island Sound or Arthur Kill, near the extreme southwestern end of the island and distant about 2½ miles from Richmond Valley station on the Staten Island Railway, about 23 miles from New York city hall.

The amber was found in connection with the clays which are mined there for manufacturing purposes (fire and ornamental brick, hollow ware, terra cotta, etc.). They are known to be of middle Cretaceous age, and are approximately the equivalent of the Cenomanian of Europe, of the lower Atane beds of Greenland, and of the Dakota group of the West. They represent the eastward extension of the Raritan or Amboy clay series of New Jersey.

FLUORITE (Chlorophane.)

VIRGINIA.

It is a fact of much interest that the variety of fluorspar[a] found at Amelia, Va., has been found extremely sensitive to heat, so that it becomes distinctly luminous by the warmth of the hand, and that it

[a] Kunz, G. F., Gems and Precious Stones of North America, 1892 p. 184.

also shows a triboluminescence so marked that the slightest friction will cause it to emit a phosphorescent light. During an examination as to the cause of this phosphorescence, in a series of experiments[a] made by Dr. Charles Baskerville and the writer, specimens were sent to Prof. William J. Humphreys, of the University of Virginia, who examined spectroscopically these and more than one hundred other examples of fluorite, obtained from almost every quarter of the globe. His experiments showed that yttrium was present in most of the specimens, and ytterbium also in a few of them.[b] These results led the writer to suggest that the chlorophane variety of fluorspar could be distinguished and separated very simply by the fact of its being both triboluminescent and also thermoluminescent even at low temperatures.

FOSSIL CORAL.

IOWA.

For many years beautiful specimens of cut and polished fossil coral from Iowa have been familiar to collectors and geologists; and there has been a constant production and sale of such material but only on a very moderate scale as compared with what it might be if the stone were better known to the public and applied to a greater variety of ornamental uses. The Iowa exhibits at several of the recent expositions have contained beautiful displays of this material; and some very elegant polished balls were shown at the St. Louis fair by Mr. Charles E. Briggs, of Lisbon, Iowa.

GEM MINERALS OF CALIFORNIA.

INTRODUCTION.

The reports of this Bureau for 1902 and 1903 have contained somewhat extended notices of the remarkable discoveries of gem spodumene in southern California, and also of gem tourmaline and of various other interesting minerals. The colored tourmaline and lithia minerals of the same region have also been separately noticed in several former reports of the Bureau. These various occurrences, together with those of other gem minerals, beryl, topaz, essonite, etc., in the same or neighboring localities, are making the whole district one of the most remarkable in the world for these minerals, comparable only to the famous gem region of the Urals. It is therefore fitting that a more general statement of the whole subject should here be presented. In this statement will be included a body of data specially collected during the last year for the writer in connection with the State Mining Bureau of California, and some notes on the geology of the region

[a] Kunz, G. F., and Baskerville, Charles, Science, 1904.

[b] Humphreys, W. J., On the Presence of Yttrium and Ytterbium: Astrophysical Jour., vol. 20, November, 1904, pp. 266–273.

from various sources, the latest being an article just published by Mr. G. A. Waring, of Leland Stanford University.[a]

It is worth while to note the fact that there is already more actual mining for gems done in California than in any other State or Territory of the Union, and the indications are that there will be many more gem mines discovered in the southern counties as remote districts are opened and old ones more fully explored.

An extensive report, to appear as a volume, on the gems and jewelers' materials of California is now in press; this was prepared by the writer at the request of the State Mining Bureau, under the direction of the State mineralogist, Mr. L. E. Aubury. A report on the occurrence of lithia minerals in the United States, by Mr. Waldemar T. Schaller, of the United States Geological Survey, is also in preparation. As the lithia minerals are so intimately connected with the gem minerals, the latter will of necessity be more or less treated of in this report. These two publications will describe quite fully the remarkable mineralogical discoveries in southern California and make them known to the world. Heretofore almost all that has appeared, until very recently, has been in the annual reports of this Bureau by the writer. The privilege of using in this present summary the data obtained for the forthcoming volume has been very liberally accorded the writer by the California State Mining Bureau. A large amount of this material has been obtained from personal communications and other unpublished sources, and is now brought together and corrected to date, so as to furnish a general view of the gem resources of the State.

The distribution of gem minerals in California as a whole may be broadly outlined as follows: (1) There is first the gold region of the central and northern counties along the western base of the Sierra Nevada; in this are found the gold quartz used so much for jewelry and ornamental work, and the few but interesting diamonds. These latter occur loose in the gold-bearing gravels, sometimes of the surface placers but generally of the old river beds now covered and compacted by lava flows. In these old river beds also is found much of the agatized and opalized wood, which is sometimes capable of use as an ornamental stone. In the same gravel filling of an ancient stream bed in Calaveras County was encountered the wonderful deposit of transparent quartz crystals (rock crystal) of great size, which yielded some of the finest material for art work ever known anywhere.[b] These occurrences, it is true, are adventitious, and not in the nature of mines that can yield any permanent supply. But they have been found, and may be found again at any time. The gold quartz is different in this respect, and a fairly steady production of it in certain of the quartz mines may be relied upon hereafter as before.

[a] Waring, G. A., The Pegmatite Veins of Pala: Amer. Geologist, vol. 35, No. 6, June, 1905, pp. 356-369.
[b] Mineral Resources U. S. for 1898, Ann. Rept. U. S. Geol. Survey, 1899.

The diamonds found in the gravels are neither numerous nor large, but some of them are beautiful and all of them possess much interest. Their occurrence was described in the paper of Mr. H. W. Turner, reviewed in the report of this Bureau for 1899. All have been found incidentally, and no search for them has ever been made. One or two suggestions, however, may be offered here.

As the United States Geological Survey is now carrying on a special study of the occurrence of platinum in the Pacific States, it would seem that if some attention were paid to the occurrence of the diamond it also might be found in the course of this investigation, as the diamond is one of the heavier minerals and would probably be met with in the riffles with the gold and platinum.

The new grease-board separator used by the De Beers Diamond Company in the African mines might prove a valuable adjunct to some of the present gold stamps, or in the sluices, to detect the occurrence of diamonds in California. The concentrates are carried with a stream of water over an inclined board coated with mutton tallow; when such a board is vibrated or "jigged," other minerals pass on, while all diamonds present adhere to the grease and can thus be separated. By this means, diamonds down to the size of a pin-point are now saved in the Kimberley mines, while otherwise they would surely be lost.

(2) There is next the region of Tulare County, centering around Visalia, where the recently developed chrysoprase mines occur at several points. This rare and beautiful stone exists here apparently in some abundance, and associated with it are other forms and varieties of quartz minerals capable of use for ornamental purposes, such as rose quartz, chrysopal, etc., besides several species of garnet, some of which have yielded gem material. Another interesting and rather peculiar stone found in this section, on the borders of Tulare and Fresno counties, is that named by the writer *californite*, a compact green variety of vesuvianite that perfectly resembles the celebrated jade so much prized in the Orient for elegant art work. This mineral is also found in Siskiyou County, at the northern extremity of the State.[a]

(3) The desert region of the southwest, bordering on Nevada and Arizona. Here, in an arid and desolate country, consisting largely of volcanic rocks, are found some interesting localities of opal and of turquoise, the latter giving evidence, as in Arizona, of long and extended working by prehistoric tribes, who have left their stone tools and their rock inscriptions around their old places of labor. These will be further referred to under turquoise.

(4) The region specially considered in the present review is the mountainous central and southern portions of San Diego and Riverside counties. Here it is that such remarkable gem discoveries have

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[a] Mineral Resources U. S. for 1901.

been made in the last ten years. Besides the richly colored tourmalines and spodumenes, other gem minerals have lately been found in various parts of this district, especially topaz, transparent epidote and axinite, pink, green, and blue beryl, and essonite garnet, the whole forming such an assemblage of minerals that is scarcely, if at all, equaled in the world. Many of these mines are as yet only prospects or trial openings, but the indications are that the region is full of possibilities. Lack of water and fuel are the chief obstacles thus far to a much more extended development.

In general it may be said that throughout the schistose and granitic region of San Diego and Riverside counties there is a widespread prevalence of an igneous rock of gray color, generally called a diorite, with a little desseminated quartz and mica (biotite); but some examples have been determined to be gabbro rather than diorite. This rock and the granite appear in a series of ridges or mountains, with a prevailing north and south course, and are traversed by dikes or veins of pegmatite, which have a general direction of northwest-southeast, and dip southward or southwestward at varying angles. It is in these pegmatite veins, which with slight differences yet possess great general similarity, that the gem minerals are found. In the notes given farther on as to the several mines the more special features will be described.

In this region several centers of occurrence of two somewhat distinct types may be recognized, those yielding lithia minerals with gem tourmaline and sometimes gem spodumene and those yielding principally garnet, beryl, and topaz. Of the former, there are especially to be noted in San Diego County first the Mesa Grande mines, which yield crystallized gem tourmaline of splendid quality almost exclusively; second, the Pala district, in which there are three parallel ridges—Pala Mountain on the west, with the great lithia mines and some colored tourmaline; Pala Chief Mountain, in which are found very fine tourmaline and the new and remarkable gem spodumene (kunzite), and Hiriart Mountain on the east, with a number of openings yielding both tourmaline and kunzite; then third, northeast of these, in Riverside County, there is the region near Coahuila, in San Jacinto Mountains. Here was the first discovery of gem tourmaline in California, so far as known to the whites, and kunzite and other lithia minerals have also been found recently in association with the tourmaline. There are also other localities between this latter and Mesa Grande, and probably many others may yet be found. About halfway between Mesa Grande and Pala is a fine beryl mine near Rincon.

The other class of mineral localities appears to lie along a line somewhat southeast of those just noted, extending from near the Mexican boundary, at Jacumba, northwest to Ramona and perhaps beyond, and following the general strike of the pegmatite veins and almost exactly paralled to the line from Mesa Grande to Pala. At Ramona are found abundant fine garnet (essonite), with topaz and beryl, notably the rose variety, but not much tourmaline, no kunzite, and, in general, little of the lithia minerals. Around Jacumba are found beryl and essonite garnet (often called hyacinth); the latter is abundant and at one or two points has been worked somewhat for several years. Jacumba, or Jacumba Hot Springs, is close to the Mexican line, some 20 miles east of Campo, and almost on the western edge of the Colorado desert.

NONCRYSTALLINE QUARTZ.

ROSE CHALCEDONY.

A very beautiful pink chalcedony, occurring in rather a peculiar manner, has been found by Mr. W. B. Coombs, of Needles, San Bernardino County. He noticed pieces of pink and also of white chalcedony as float material in washes or gullies about 3½ miles west of Siberia station, a siding on the Santa Fe Railway. Following these up several gulches he traced them to outcroppings of small quartz veins in a granitic rock that had apparently been altered by some volcanic action. The locality is near what is known as Ash Hill, and there are porphyritic rocks and old craters in the vicinity.

HYDROLITE.

Among the interesting specimens of chalcedony found at various points along the Pacific coast of California and Oregon, one of the most remarkable is mentioned as having been found on Pebbly Beach, Crescent City, Del Norte County, Cal. This specimen was a geode 4½ inches in length and 3½ by 3½ in the other dimensions and contained a teaspoonful of water with a moving bubble. It was reported by Mr. Frank Clovenow, of Pebbly Beach. These hollow geodes of chalcedony, containing water, which have been called natural sealed flasks and also hydrolites, have been long known from some of these Pacific beaches, and have been sought with much interest by collectors, but nothing approaching the size of this specimen has ever been found before.

CHRYSOPRASE.

The last reference to the chrysoprase occurrences in California in the reports of the writer to this Bureau was in the report for 1901. The following general summary is derived from recent data gathered in connection with a report to the State mining bureau of California. Chrysoprase was discovered in Tulare County in 1878 by Mr. George W. Smith, a surveyor, of Visalia. He presented specimens to Mr. M. Braverman, of that place, who identified them as chrysoprase from the presence of nickel oxide. Later the State mining bureau confirmed this determination. The first specimen was the finest ever found in America, and was sent to the Paris exposition of 1879, but failed to reach its destination. It was about 3½ inches long and 1½ inches thick. The first discovery and thus far the best outcroppings developed are located on the McGinnis property in the NE. ¼ sec. 8, T. 18 S., R. 26 E., Mount Diablo meridian, about 10 miles northeast of Visalia, on Venice Hill. These outcroppings extend along the southeastern slope of this hill and through section 8 and the SW. ¼ sec. 4. Here it occurs in small, irregular veins, which range from mere seams to a thickness of 2 or 3 inches, in a somewhat altered red jasper rock.

The chrysoprase outcroppings have been traced at different places all along the foothills of the Sierra Nevada across Tulare County, and the following localities have been noted by different authorities: Venice Hill, Stokes Mountain, Tule River, Deer Creek, and 1 mile east of Lindsay. All of these localities have been announced in the annual reports of the writer on the production of precious stones in the United States for 1895 to 1898, inclusive.

OPAL.

A considerable deposit of opal is reported in San Bernardino County at a point about 25 miles northwest of Barstow or north of Hinckley, both of which are stations on the Atchison, Topeka and Santa Fe Railroad. Mr. C. E. Dolbear, of Long Beach, Cal., describes the opal as occurring in a fine-grained, brittle, andesite tufa, in which it forms narrow bands, sometimes widening to a thickness of several inches. Most of it is semiprecious and amber colored; but some 25 specimens of a bright rose pink were obtained, one of them weighing 2½ carats. Other accounts state that the opal is found in an indurated clay overlain by tufa, and that the deposit extends for a length of 2 miles with a breadth of half a mile. Further details of this occurrence are to be desired.

TURQUOISE.

An account was given in the report of this Bureau for 1898 of remarkable discoveries of ancient turquoise mines in southern California. These have been followed up, and a good deal of exploitation has been done, although the region is very barren and inaccessible. Turquoise mines now exist in a considerable area in the northwestern angle of San Bernardino County, and are operated by the Himalaya and the Toltec mining companies. The latter company has three groups of mines, all of them patented, situated on the great desert about 100 miles northwest from Needles Station and about 50 miles northwest of Manvel, which is on a branch of the Santa Fe Railroad. The three mining centers are some 6 miles apart in the old Solo mining district, and are known as East Camp, Middle Camp, and West Camp, the latter being within 20 miles of Death Valley. The altitude is between 5,000 and 6,000 feet; and as there is no water at either camp, it is necessary to haul it over mountains from 1 to 5 miles. The same company has also operated turquoise mines in Nevada, some 60 miles due east of the California mines. The other company, the Himalaya, has a group of five mines in the same district (the Solo), but some distance from those of the Toltec, being about 60 miles northwest of Manvel, and reached only by teams. These claims are all on one ledge, which is described as a "bird's-eye porphyry" with some granite, striking north and south, with a dip of 75° west.

INDIVIDUAL MINES AND THEIR MINERALS.

The account of the several main openings and their condition in 1904 is as follows:

These data are grouped geographically, and to some extent also in the order of discovery, beginning in Riverside County and proceeding southward and southeastward through San Diego County, by Pala, Mesa Grande, and Ramona, to the Mexican line at Jacumba.

RIVERSIDE COUNTY.

COAHUILA DISTRICT.

The most northern occurrences and the earliest discoveries of gem tourmaline were made here in Riverside County as far back as 1872, but they were not announced to the public, and the facts were little known until twenty years later.

FANO KUNZITE-TOURMALINE MINING COMPANY.

KUNZITE AND TOURMALINE.

This mine consists of four claims about 3 miles north of Coahuila Indian Reservation, and was located in 1902 by Mr. Bert Simmons. The nearest post-office is Hemet, Riverside County. An experimental tunnel has been carried into the ledge to a depth of 176 feet in solid blue granite, but most of the work has been done near the surface. The ledge is about 5 feet wide, striking northwest and southeast, with a dip to the southwest of 17°. The pegmatite is finely crystallized and resembles that of the other tourmaline and kunzite mines in the district.

Three men are at work at an average wage of $3 per day, and operations will be continued indefinitely. The output so far has been 25 pounds of kunzite, white; 1 pound of kunzite, pink; and 25 pounds of all classes of tourmaline, mostly blue and green; about 250 pounds of beryl have also been taken out, but only about 5 per cent of it is available for gem purposes. Two hundred pounds of very fine quartz crystals have also been sold, and about a ton of lepidolite and 30 or

40 pounds of amblygonite; also, splendid flake mica has been discovered large enough for commercial purposes. There is a spring near the property on land rented by the owners of the mine. There is also plenty of oak timber for mining purposes. Considerable money has been expended without much result, but for the work actually done on gem pockets, this mine has been a splendid producer.

COLUMBIA MINE.

TOURMALINE.

The Columbia, the oldest tourmaline mine in the State, situated at Coahuila, Riverside County, is about one-half mile northwest of the road leading from Coahuila to the Hemet reservoir, at an altitude of about 5,000 feet. Very little has been done here for over five years, but it was the first tourmaline mine discovered in southern California in 1872, and it has produced a great many beautiful gems. The pockets, however, seem to have been worked out, and nothing important has been found recently.

The ledges of pegmatite are of very fine granite, and both sides of the pocket material seem to be of the same character, thus differing from any other mine in the gem district. Considerable work is proposed in the near future, but the mine is in litigation. There is no water or timber available and the region is barren.

SAN DIEGO COUNTY.

Passing southward from the Coahuila district into San Diego County the locality next described lies by itself, about half way to the great Mesa Grande-Pala line of mines. Although not yet an important producer, the occurrence is interesting, as suggesting other possible localities yet to be discovered in the intervening area.

GEM MINE NO. 1.

TOURMALINE.

Practically no work has been done on this mine since its location in June, 1903. Its altitude is higher than that of any other gem mine in San Diego County, being 5,100 feet above the sea; it is on the top of the divide between San Luis Rey River and Temecula Canyon, and about 1 mile east of the summit of Aguanga Mountain. The average width of the vein is apparently about 4 feet, but it is much broken; both foot and hanging walls are of very hard blue diorite. Great pressure has apparently crushed the ledge, and the pocket layer is found on the top, out of place, between the diorite and the pegmatite; it presents fine, broken crystallizations of orthoclase and albite, in which a red clay is mixed. The tourmaline crystals show much indication of dynamic action, being badly broken and twisted, but they afford nodules of beautiful coloring, deep blues, reds, and an almost emerald green predominating. So little work has been done, however, that it seems better to reserve any report as to quantity and quality until more is ascertained. There is no wood at hand, and it is 3½ miles to the nearest water. Parties are at work at present, however, and will send specimens direct to the State Mining Bureau.

PALA DISTRICT.

As elsewhere described in this report, the mines near Pala are located on 3 hills or ridges, the western being properly called Pala Mountain, on which are the great lepidolite, or Alvarado mine, and the Stewart mine, next described, which yields some gem material. The other mountains, Pala Chief and Hiriart, which are apparently foothills or spurs of Agua Tibia Mountain, are those yielding gem spodumene as well as tourmaline. About 18 miles to the southwest, but probably belonging to the same range of hills, lie the great tourmaline mines of Mesa Grande. These will be given in the order stated.

STEWART MINE.

TOURMALINE.

This mine, said to have first been discovered by an Indian deer hunter named Vensuelada in the early days of California history, was first worked by a miner named Henry Magee, who located the claim as a quicksilver mine, mistaking the pink tourmaline for cinnabar, but upon analysis he abandoned his prospect. It was next located as a rock claim by Don Tomas Alvarado, a Mexican landowner, who believed that the beautiful bluish, pinkish, and gray mineral studded with deep-pink crystals was a peculiar variety of marble. Several years later a German scientist, familiar with lithia mines in Europe, saw a specimen of Pala lepidolite in New York. Obtaining a piece, he made an analysis and found the ore to be as rich in lithia as any in the world. From this time forward gradual development under many ownerships has proved that great deposits of lithia-bearing ores exist in the pegmatites of this district, the largest and most valuable being the Stewart and Alvarado mines. The latter is the great lepidolite and amblygonite mine that has yielded so many beautiful specimens of radiated pink tourmaline, but no gem material.

The workings and surface of the Stewart mine show numerous indications of gem minerals, especially in the lower workings. As in the Alvarado mine, the lepidolite is generally studded with small, fan-shaped crystallizations of rubellite, and with occasional crystals of bluish or greenish tourmaline, but not of gem quality. Near the surface the tourmalines are small and perfectly crystallized, but are more or less fractured, opaque, and unfit for jewelers' use. In the deeper workings and in the extreme western tunnels, however, pink tourmalines from one half inch to 1 inch in diameter are found in columnar groups, all more or less altered and not over 3 in hardness, associated with quartz, orthoclase, gray lepidolite, and amblygonite. Triplite and triphylite occur as associated minerals. Large crystallizations of what appears to be an altered spodumene were observed penetrating the quartz. On the surface small green tourmalines are found in the pegmatite, generally more or less flattened between the cleavage planes of muscovite mica. Several years ago a pocket containing about a quart of small tourmaline crystals was found in coarse pegmatite 60 feet south of the present tunnel of the Stewart mine. Some of these crystals were cut into very good gems, but no further work at that spot has been done. With proper development this mine should become a paying producer of tourmaline.

PALA CHIEF MINE.

TOURMALINE AND KUNZITE.

This mine was located in May, 1903, by Messrs. John Giddens, Pedro Teiletch, Bernardo Hiriart, and Frank A. Salmons. The claim covers 1,500 by 600 feet, running northwest and southeast. The main workings are at an altitude of 1,220 feet and consist of open cuts 250 feet wide, extending to a depth of 10 to 30 feet horizontally on the vein; at the deepest working the ledge is 21 feet in height. A tunnel 45 feet long was run to encounter the vein up to about 20 feet in depth, but it was found that the ledge was a blanket vein, and nothing was discovered in the tunnel. In the upper or surface workings the hanging and foot walls were both found to be of bluish and grayish decomposed diorite. The upper part of the vein consists of 3 feet of finely crystallized white pegmatite; beneath this the crystallizations become coarser and more granitoid; the third layer is composed in part of finely crystallized albite and orthoclase, upon the lower edge of which and extending to the pockets is a layer of lithia-bearing micas. Within the pockets, which are generally from 8 to 10 inches wide, pinkish and white talc is found, in which are numerous large and perfect quartz crystals, with pink and white spodumene. As usual in the region, the lower half of the ledge below the pocket line is a very finely crystallized granite without mica, with small crystals of essonite garnet. Giant powder has been used exclusively, and has been found to be the only satisfactory explosive. Two men have been working nearly all the time, but during the last 6 months with no great success. There is no timber on the property, and the nearest water is about 1 mile away. The section and township in which the mine is located were not determined, but it lies 3 miles east of Pala, and the workings can be seen from the town.

The minerals noted were spodumene, pink, lavender, and white; tourmaline, blue, green, and red; orthoclase; albite; graphic granite;

lepidolite, pink, green, and lavender; muscovite; quartz crystals; steatite, and other clays.

The products so far noted are tourmaline, kunzite, and quartz crystals.

TOURMALINE QUEEN MINE.

TOURMALINE.

This mine is near the summit on the northeast slope of Pala Mountain at an altitude of 1,450 feet. It is about 3½ miles north by a little east of the town of Pala. The mine was located as a quartz claim in March, 1903, and is 1,500 by 600 feet and runs north 34° west. The vein is about 14 feet wide and dips to the southwest 15°. Little has been done on this property, save scalping work; an open cut 60 feet wide, entering the vein to a depth of about 10 feet, produced some 80 pounds of gem tourmaline crystals. The colors are yellow, green of different shades, light pink, ruby red, and black. In the ledge 18 inches of material lying between the diorite hanging wall and the coarse pegmatite appears to consist of decomposed feldspar, which passes gradually to pegmatite. Below this are about 3 feet of coarse granular pegmatite, consisting of crystallized quartz, feldspar, and muscovite, with black tourmaline in fan-shaped crystallizations and minute essonite garnets, also occasional crystals of biotite and hornblende. Below this again, and merging with the above, are masses of graphic granite, incrusted at the lower edge with albite, in which the gem tourmaline seems to have a root or extremity. Between the albite and the line rock are large pockets filled with rose and lavender colored muscovite, and decomposed feldspars in the form of a whitish or pink clay; in these pockets the gem tourmalines are found, often broken and more or less altered. Many crystals show an exterior of opaque green, while the interior is a rich pink or ruby red, affording beautiful gems. The ledge has been prospected for about 250 feet, and shows gem indications wherever opened. The hanging wall is a coarse greenish and grayish diorite, like the general formation of the entire belt. The foot wall is the same, though showing more alteration.

Both giant and Judson powders have been used in mining, although from the hardness and toughness of the rock the former was found to be the best. After the pocket material has been extracted, screens are used, by which the earth and fine worthless material are eliminated. The matter left in the screens is then examined for gems and afterwards washed. Two of the owners have performed all the work so far accomplished. Active operations were to be resumed about January 1, 1905, but nothing was done in 1904. The same parties have filed on a spring 350 feet northeast of the present workings, and abundant water for mining and domestic purposes has been developed.

The minerals noted in this claim are tourmaline, albite, orthoclase, muscovite, lepidolite, kaolin, talcose clays, essonite garnets, hornblende, and indications of epidote. The lower part of the ledge is composed of a fine, granular, mica-free granite of a gray color, banded at intervals of from 3 to 6 inches with minute essonite garnets, whence the name line rock. As in all the pegmatite veins in this region, this lower portion has about the same width as that of the formation from the pocket layer or center to the top and lies directly upon the diorite foot wall.

TOURMALINE KING MINE.

TOURMALINE.

This mine is situated on the north slope of Pala Mountain, about 300 yards from the summit, at an altitude of 1,540 feet. It was located in March, 1903, but very little work has been done, so that it is hardly possible to make a definite report. The mine is 4 miles directly north of Pala and is the last mine so far discovered at the western extremity of the Pala mineral belt. The claim runs northeast and southwest and is 1,500 by 600 feet. The vein dips to the southwest at an angle of $16\frac{1}{2}°$, with an average breadth of 7 feet, and is essentially coarse pegmatite, but shows evidence of crushing and is badly broken in many places. The hanging wall is a coarse, gray diorite, and at the place where the work was done lies over about 15 inches of coarse, broken feldspar and lepidolite.

It is in this stratum that the gems appear, unlike the general pocket formation of the Pala district. Tourmaline was the only gem stone noted, and occurred in pencils, disseminated through this altered mass of decomposed spar, and apparently out of place. Concretions of albite, coated with beautiful purple muscovite, were found loose in the soil. The ledge here was too badly broken to note the exact character of the pegmatite, and the line rock or lower stratum had not been uncovered, so that its character could not be determined. No work has been done here for several months, and nothing definite could be learned as to when it would be resumed. About 10 pounds of crystals were secured in a cut 12 feet wide, barely scalping off the top layer of earth.

NAYLOR-VANDERBURG MINE.

KUNZITE.

This mine, also near Pala, lies at an altitude of 1,400 feet, on the eastern slope of Mount Hiriart. The location was made by Mr. F. M. Sickler in February, 1903, soon after discovering that the pink and white crystals that he had found on the mountain side were not tourmalines, as had been supposed, or any stone known to local mineralogists. After considerable trouble and expense Mr. Sickler, still believing the stone to be of some value, continued his investigations. He at length sent a piece to New York to the writer, who determined it as spodumene, and after whom it was subsequently named kunzite by Prof. Charles Baskerville, of North Carolina, as a new gem stone—the first occurrence of transparent pink or lavender spodumene in the world. The ledge in this mine, at the point examined, was 16 feet in width, but badly broken. An open cut about 30 feet wide, entering the vein to a depth of 22 feet, has produced approximately 5 pounds of perfect gem kunzite. Several pieces have also been found in adjacent workings, but this seems to be the best part of the ledge. The hanging wall is gray orbicular diorite. Between this and the ledge itself a layer 18 inches thick of decomposed feldspar and clay was found as a gouge. About 7 feet of coarse granitic pegmatite forms the upper part of the ledge, altering into decomposed layers of albite and orthoclase. In this latter are small pockets, seldom larger than a man's hand, in which one or two crystals of kunzite are found, completely embedded in yellow, pink, or white clay. No metallic stains appear in the upper part of the ledge, but the lower beds of granitic rock interlined with garnet are in many places stained with manganese and show large crystallizations of triplite, from which it is evident the kunzite receives its coloring. The vein dips 10° to the west and extends the full length of the location, 1,500 feet, joining the Katarina mine on the south. There is no water or timber on the property, and neither are available except by buying adjoining land. The claim lies within the boundaries of the Pala Indian Reservation, although it was located before the reservation was declared, and there has hence been some controversy as to the validity of the title.

The minerals noticed are muscovite, pink, green, and lavender, in very large scales; montmorillonite and steatite talcs; pink, green, and white spodumene; and black tourmaline, but no gem tourmaline. Albite and orthoclase, with some potash feldspars, are the mother of crystallization. The output here since the beginning of work has been about 10 pounds of gem kunzite, no other minerals having been disposed of. Some pink and green beryls were noticed, but nothing has been developed in that line.

Other claims and openings on Mount Hiriart are enumerated in the report of this Bureau for 1903, this one being thus far the most important.

MESA GRANDE DISTRICT.

The mines are situated on Mesa Grande Mountain and are the most southern of the gem tourmaline localities in the region, on the ridge stretching down southeastward from the Pala and Agua Tibia mountains, already described. To the west is another locality for tourmalines, at Vista; and northward are, first, the Oak Grove location, and farther on those near Coahuila. Several mines have been opened on the Mesa Grande, the Himalaya Mining Company occupying the west side of the ridge and the San Diego Tourmaline Company the east side.

HIMALAYA MINE.

TOURMALINE.

This mine is situated in the east half of sec. 17, T. 11 S., R. 2 E., San Bernardino meridian, at an altitude of 3,800 feet. The property is about 4½ miles northwest of the Mesa Grande store and on the watershed between San Luis Rey River and Mesa Grande Creek. It had long been known that beautiful colored stones existed on this ridge, but after repeated failures and with no determination of quality or value the locality was brought into notice in 1898 by Mr. Charles Russell Orcutt, who opened it and for a time worked it; afterwards it was operated by Dr. A. E. Heighway. This led to later development by the Himalaya Company, and the present output is the result. During 1904 about 6 tons of rough tourmaline were shipped to the company's lapidary in New York. Of this quantity about 350 pounds were fine nodules and pencils of the very highest grade. Surface or bench digging has been followed exclusively, although a tunnel is being run to tap the ledges at the 150-foot level. Both hanging and foot walls are of hard blue diorite and the ledge is of fine crystallized pegmatite not over 18 inches in width, and dipping from 26° to 33° southwest. In working this ledge pay material has been in sight continuously, and at no time has a barren piece of ground been encountered. The upper pegmatite is usually stained with lithia and manganese, and large masses of lepidolite are associated with tourmalines. The pockets are large and filled with talc and hydrous micas in which the gem crystals occur embedded, many showing peculiar etchings. The ledge has been uncovered for about 700 feet and to an average depth of 15 feet. These open cuts, however, are proving dangerous and will have to be abandoned as soon as the rainy season has soaked the walls on either side. Wood, water, and all natural advantages are of the best, and a good dwelling house, barn, tool houses, and blacksmith shop, a windmill, and water piped to all constitute the improvements. From 4 to 10 men are constantly employed about the mine.

Among the minerals noted were orthoclase, albite, lepidolite, amblygonite, small clear pieces of spodumene, muscovite; tourmaline, black, green, blue, deep red, and rose pink; beryl, pink and aquamarine; hornblende and epidotic rocks, spessartite and essonite garnet, large and very transparent quartz crystals, talc and hydrous micas, and a dark-brownish transparent crystal, very dense (specific gravity, 10), and with a hardness of 5½, not yet identified. This mineral is very rare, and only a few pieces have been found.

SAN DIEGO TOURMALINE MINING COMPANY.

TOURMALINE.

The mines are situated in the east half of sec. 17, T. 11 S., R. 1 E., San Bernardino meridian, and about 4 miles northwest from Mesa Grande post-office. This property was opened by Mr. Gail Lewis at the time of the first discoveries on this mountain. He had but small success at first, but persevered and reached a fine pocket of gem material just before his option expired. The mine has been developed more elaborately than any other of the district and carried much deeper. Fine gem tourmalines are taken out at a depth of nearly 200 feet, the greatest depth at which these gems are obtained anywhere in the world. A tunnel 120 feet long was run, tapping the ledge at 64 feet; from this, drifts were run about 150 feet in both directions, and the ledge matter was stoped to the surface; tourmalines in paying quantities were then extracted. Later a tunnel was run 286 feet in length, tapping the ledges at from 145 to 170 feet, and drifts from 20 to 30 feet long were run on two ledges which were struck. The ledge matter is a fine-grained pegmatite, showing on both top and bottom black tourmalines in fan-shaped crystallizations. Near the center, at intervals, pockets occur in which fine gem tourmalines are found, though not as rich as in the adjoining claim, the Himalaya, just described. This company has employed from 3 to 7 men continuously, and is doing good work, timbering the workings as they are made and doing scientific mining. The company has its own lapidary in San Diego, where most of their product is cut. Wood, water, and all facilities are at hand. Giant powder has been used exclusively, and the blasting has not resulted in the breaking or destroying of any crystals. The ledges are over 18 inches in width and are generally of a character which would not be prospected, looking barren and worthless, but the locality seems to be highly mineralized, and any ledge shows gem crystals.

Other mines are being opened in the vicinity, and probably during 1905 there will be a great development in the Mesa Grande section. One recent opening may be noted in particular.

ESMERALDA MINE.

TOURMALINE.

The Esmeralda mine is situated about 5 miles northwest of the Mesa Grande store and $1\frac{1}{4}$ miles west of the Himalaya mine, on the eastern slope of the Temescal Valley. It was located by Mr. Dougherty late in 1903 or early in 1904, and covers 1,500 by 600 feet. The course of the ledge is northeast and southwest, but the claim lies across a spur running southwest and northeast at right angles with the main ledge at an altitude of about 3,500 feet. The work consists of two open cuts crossing the vein and exposing it to a depth of $7\frac{1}{2}$ feet; a tunnel of 60 feet below the surface workings tapped the ledge at 28 feet; but no further work has been done in the tunnel, and no gems were found in the formation at that place. Both hanging and foot walls are composed of a coarsely crystallized hornblende-diorite of a rich grass-green color, resembling a serpentine. The ledge itself is a coarse granitic pegmatite, and is faulted in several places. The pockets are quite large, and contain quartz crystals, orthoclase, and albite in beautiful transparent crystallizations. Lepidolite in pieces weighing from 50 to 300 pounds also occurs in conjunction with the pocket material. In the ledge $2\frac{1}{2}$ feet of pegmatite overlies the pocket stratum. The pockets themselves are filled with soil and foreign matter, rendering it impossible to say exactly what was the nature of the softer material that once filled them. Some pockets are hollow, containing only quartz crystals, while near them are other pockets absolutely filled with tourmaline pencils. The lower stratum or line rock of these ledges is also pegmatitic, although of much finer crystallization than the top. About 250 feet southwest of the tourmaline workings the ledge is badly broken and shows only in places, in the nature of blow-outs of pegmatite and quartz. In some of these blow-outs golden and aquamarine beryl were found "frozen" in the formation. There is neither wood nor water on the claim, but an abundance of timber can be secured within half a mile, and water can be piped to the mine from springs on the hill.

Tourmaline is the only perfect gem found, and occurs in pink, bright red, azure blue, aquamarine blue, and a peculiar shade of green blue, which cuts to a stone in which one set of facets show a sapphire blue and another set a rich emerald green. Crystals of this kind have not been noticed in any other tourmaline mine in southern California, although fine blues and greens exist in other places. With the lepidolite is a granular blue and lavender mineral which could not be determined, but apparently it is a lithia compound. Many of these were of excellent gem quality, and the owners intend doing considerable development work at these places. About $300 has been expended, producing about 20 pounds of tourmaline of gem quality. As in many other cases of prospecting and mining for gems in southern California, lack of funds has greatly hindered the proper development and exploiting of this mine.

RINCON DISTRICT.

The mine next described does not furnish either gem tourmaline or kunzite, but is worked as a beryl mine, some fine material having been obtained. It lies on the Pala belt, about halfway between Pala and Mesa Grande, on Palomar Mountain, which is a spur or foothill of the Smith Mountain ridge, with which Pala Mountain is closely related, and hence it is considered here.

MACK MINE.

BERYL.

This mine is located at Rincon, San Diego County, 9½ miles southeast of Pala, in sec. 25, T. 10 S., R. 1 W., San Bernardino meridian. It was discovered in November, 1903, by Mr. J. M. Mack and an Indian named J. Calec, near the Rincon Indian Reservation. The exact locality is 1¼ miles northeast of the Rincon store, in the first canyon east of it, at an altitude of 1,960 feet. The ledge dips 45° to the southwest, and is exposed on the hanging wall for about 75 feet; all work has thus far been confined to the surface. Fine gem beryls have been found, and also a peculiar opaque, deep blue variety, different from any elsewhere known in the county. These crystals should be analyzed. Much development work during 1905 is contemplated. The ledge is essentially pegmatite, with an average width of from 5 to 6 feet, with a gray granite footwall. The hanging wall is hard to determine, as much rock had fallen and covered it, but it is apparently a blue and gray diorite. The pockets are very narrow and are confined exclusively to a "bony" crystallization of orthoclase, in which most of the beryls are attached. Wherever a pocket is found in which clays or other soft substances are the matrix, the crystals are exceptionally fine and can be cut into perfect gems. So little work has been done that it is hardly of importance to report this locality if it were not for the peculiarity of the crystals found. There is a small spring of water on the property and some sycamore and oak timber.

RAMONA DISTRICT.

South of all these localities lies a separate group of occurrences of garnet with beryl and in some cases topaz centering around Ramona, and also the garnet country far to the southeastward in the vicinity of Jacumba. These suggest a line or belt of garnet and beryl southeast of the tourmaline-kunzite line and parallel to it; but it is not possible yet to say how far this idea may be correct. The garnets belong mainly to the essonite variety, although many of them are called spessartite (manganese garnet); but the writer is not satisfied that this latter species really occurs. Both varieties are often called hyacinth by jewelers, and at many of these points they present rich orange and fulvous shades between red and yellow.

A B C MINE.

BERYL, TOURMALINE, ESSONITE AND SPESSARTITE GARNET.

This mine was discovered November 1, 1903, and is situated in the SW. ¼ NW. ¼ sec. 8, T. 13 S., R. 1 E., San Bernardino meridian, and at an altitude of 1,950 feet. It is about 4 miles northeast of Ramona.

The vein has an average width of 7 feet, and runs north 35° west, with a dip of 12° to the southwest. The claim is 1,500 by 600 feet and embraces two promising ledges. Three places have been opened at the eastern extremity of the claim at intervals of about 50 feet. The first two are in open cuts, in which the scalping process was employed and gems were taken from broken-ledge matter and soil. The principal working, however, consists of a tunnel 18 feet long, from which a stope following the pay shoot for 45 feet has been run. Both foot and hanging walls are of a gray decomposed diorite, in which the feldspar has been much altered, with some quartz and biotite. The ledge shows first some 3 feet of coarse, poorly crystallized pegmatite, stained in some places with iron and manganese. Many black tourmaline crystals with terminals pointing directly toward the pockets were observed, somewhat altered to quartz and muscovite. Below the pegmatite is a stratum from 1 to 6 inches thick of a grayish or whitish decomposed orthoclase, with disseminated crystals of muscovite having a pinkish and lavender tinge on the outer edges (probably a lepidolite border, as sometimes noted elsewhere). In this stratum, coated with albite and clay, pink beryls are found, generally solitary in a pocket, with two or three large blackish-green tourmalines. Quartz crystals were observed on both the top and bottom of this stratum, but not in the pockets with the beryls. It was also noticed that the pink-tinged muscovite was not in contact with the beryl crystals. Contrary to what is usual in ledges of this character, the edges of the pockets do not touch between the upper and lower strata, but continue through the entire working without interruption, although widening and narrowing in places. No other minerals were found existing in the same pocket (or rounded mass of clay and decomposed spar).

Underlying this beryl-bearing stratum is about 18 inches of a soft albite, angular in crystallization, and with numerous holes penetrating the mass. In these cavities minute essonite garnets were seen, also spessartite (?) and hundreds of small black tourmalines, penetrating in every direction. No gems, however, were found among these. This stratum of albite lies "frozen" to the line rock, which constitutes the base of the ledge. The line rock is coarse and shows less interlineations than at any other mine observed in this vicinity. In places large portions of graphic granite occur, embedded in the upper stratum of ordinary pegmatite. In this graphic granite are small cavities containing steatite and montmorillonite, with lithia mica occurring at intervals. Minute whitish crystals were found in these talcs which appeared to be topaz, although too small for identification. In some places, also, where quartz crystals were found disseminated crystals of pink muscovite occur, embedded and penetrating. Giant powder was used exclusively.

The minerals noted were pink beryl; green, dark green, and black tourmaline crystals; essonite and the so-called spessartite, sparingly; lepidolite, muscovite, and biotite micas; albite and orthoclase feldspars; montmorillonite, steatite, kaolin, and stains of manganese and iron. Altogether several pounds of pink beryl have been produced. Some of these stones have been cut by local lapidaries and show a rose-petal pink. They possess considerable brilliancy and are remarkably free from hairs, flaws, or bubbles. One cut stone, weighing 30 carats and without a flaw, has been on exhibition at the jewelry shop of Mr. John Hetzel in San Diego.

LITTLE THREE MINE.

TOPAZ, TOURMALINE, SPESSARTITE GARNET.

The Little Three Mine was discovered in May, 1903, by Mr. H. W. Robb. It is situated in the NE. ¼ SE. ¼ sec. 8, T. 13 S., R. 2 E., San Bernardino meridian, at an altitude of 1,940 feet, and is about 4½ miles northeast of Ramona, the nearest base of supplies. The vein runs north 35° west and dips to the south at an angle of 20°, with an average width of 4½ feet. The work so far consists of open cuts. As the vein is naturally exposed for about 60 feet on the hanging wall, it has been possible to commence work where the vein enters the ground and to break open the ledge of the pegmatite to where the pockets occur in the center. About 60 square yards of the vein have been uncovered in this manner, showing some very interesting conditions of formation. At the southeast extremity of the workings spessartite garnet was encountered, associated with small green beryls in pockets of decomposed albite, orthoclase, and muscovite mica. In this portion of the ledge no tourmalines of any color nor any topaz were found in the pockets, but black tourmalines were thickly interspersed in the upper or pegmatite portions of the vein. The line rock forming the base of the ledge has parallel wave-like bands of minute black tourmaline. The associated minerals at this part were only quartz crystals and some beryl. A concentric band of hematite and ferruginous quartz seems to separate this particular pocket from the other pocket material of the ledge.

Northwest from this pocket a gradual change was encountered and a barren condition for about 10 feet. Then coarse, bone-like concretions of albite were first discovered, with large and perfect quartz crystals. The interior of the pockets found with these minerals has either been decomposed completely and washed away or else the pockets were hollow, without any filling, as they are now filled with soil, apparently the same as that of the hillside above the ledge. In this loose soil and "frozen" to the albite and orthoclase are numerous wedge-shaped crystals of topaz, some of which weigh over a pound; they are white, sea green, sky blue, and light yellow in color. Attached to the roof and floor of these cavities and with a long root extending up into the quartz and pegmatite are gigantic tourmaline crystals, deep green, mostly opaque, some of them 5 inches in diameter and weighing as much as 15 pounds. Some small pencil tourmalines of a deep-green color and gem quality are found loose in the pockets, and many small topaz crystals that have become detached from their matrix of albite. Purple and pinkish muscovite in very large crystallizations and "frozen" into nuggets are also observed loose in the pockets or attached to the albite. Usually these crystals of mica are attached to each other at right angles, and in these angular cavities very perfect topaz crystals have formed.

The ledge proper is a fine-grained pegmatite, with foot and hanging walls of gray decomposed diorite. The underlying line rock in the topaz locality assumes a banded appearance, very straight in its interlineations. It is coarser than is generally seen in ledges of this kind, and is notable for the absence of either garnet or tourmaline in any quantity, the lines or bands being apparently a stain from manganese. A little biotite was also seen. This is a very persistent ledge, and can be traced without a break for over 3,000 feet, with an average width of 4 feet. No work has been performed other than that described, but the ledge shows indications of garnet for its entire length. This mine is a westerly extension of the Surprise mine, next to be described. There is abundant oak and sycamore timber at hand and a spring of water sufficient for domestic uses, which can probably be developed for mining purposes also. Giant powder has been used exclusively, and no bad results have been reported. Pocket material has been extracted, and the gems taken out by the screening process only, and quite a quantity of small crystals of good quality were found in the tailings. Active operations will be shortly resumed, when it is contemplated to tap the ledge about 30 feet below the present workings.

The output of this work has been approximately 30 pounds of topaz, 50 pounds of all classes of tourmalines, and a small quantity of spessartite garnet. Beryl pseudomorphs after topaz were also noticed, badly checked, but of pinkish and light yellow colors; also quartz pseudomorphs after the topaz, in square and rhombic prisms, are found loose in the topaz pockets.

SURPRISE MINE.

TOPAZ, BERYL, TOURMALINE, SPESSARTITE GARNET.

The Surprise mine, adjoining the last, is situated in the NW. ¼ SW. ¼ sec. 9, T. 13 S., R. 2 E., San Bernardino meridian. It was discovered on land owned by Mrs. G. M. Stone, November 1, 1903, by Mrs. J. W. Booth, who noticed a few spessartite garnets sticking in the pegmatite. The vein runs nearly east and west, with a slight trend to the northwest and southeast. It dips southward about 20°, and has an average width of 3½ feet.

Two places have been opened on the ledge at intervals of about 300 feet, each showing an entirely different condition in the formations. The first is about 250 feet north of Mr. Booth's residence, which is the stage station between Fosters and Julian. Here the pegmatite is finely crystallized and about 18 inches thick under a hanging wall of micaceous diorite. The pegmatite contains considerable graphic granite, with greenish stains, crystallized quartz, clear and white, and muscovite of a rich grass green. Beneath this is an average thickness of 1½ feet of decomposed albite and orthoclase and infiltrated sand and earth, with some hydrated muscovite and black tourmalines, many of which are altered to muscovite and quartz. Disseminated through this friable mass are spessartite garnets, varying from deep red to light honey yellow, affording beautiful gems, some of which have been cut and weigh from 3 to 6 carats. About 5 pounds of these were taken out of a cut running along the ledge about 6 feet in depth and 18 feet long, with an average width of 4 feet. Beneath this is the usual "line rock," in which no garnets, but banded lines 2 to 3 inches apart of minute black tourmalines, were observed; this would indicate that a higher crystallization of the ledge forces the lower into the wall or outer rock, as garnets are always found to occur in the lower rock of tourmaline ledges, while the tourmaline is found in this locality as embedded crystals in the lower rock of garnet-bearing ledges. Some broken quartz crystals which appear to have been etched either by fluorides or some other chemical compound, are disseminated with the garnets.

The second working lies east of the first between foot and hanging walls of gray micaceous diorite. The pegmatite here is very compact and finely crystallized, is stained with iron and manganese, and shows serrated black tourmalines. In the center of this ledge, between the gray base rock and the upper pegmatite, are 6 or 8 inches of orthoclase, somewhat altered, and containing small pockets 2 or 3 inches in diameter, filled with fine granular ferruginous quartz. In this sandy filling are found topaz crystals, usually coated with a talcose clay. Those near the surface were mostly white or colorless, while at a depth of 6 feet the color had changed to sky blue and aquamarine blue. About 4 pounds of these crystals have been taken from a cut 20 feet long and extending 8 feet in depth on the incline of the ledge. Several very fine pink beryls were also obtained, one 6 inches long and 1½ inches in diameter, having 3 perfect sides, being the largest crystal yet found. About 2 pounds of pink beryl have been the output so far. The above quantities of spessartite, topaz, and beryl have been extracted at an expense of $250. Giant powder is used exclusively, but no work is in progress at present; development is contemplated after January 1, 1905. This mine is an extension of the Little Three mine adjoining it on the northwest. The same persons own several other ledges in the same vicinity, which traverse four quarter sections of land owned by them, and lie in a line extending east from the present workings. Timber and water are both available in sufficient quantities for mining purposes. The stones are extracted in both localities by screening and washing.

In some of the topaz pockets a yellowish, reniform, compact, and extremely heavy substance was noted. The specific gravity of this mineral and its peculiar color have attracted the attention of several people, but it was impossible, with the means at hand, to determine it. From the edge of the pockets containing these nuggets were found radiated black tourmalines, altered to a micaceous substance of emerald and sea-green color, with occasional tinges of purple and rose-pink. This alteration seems to be an allied mineral to the one above noted. Some triplite and magnetic iron occur at the junction of foot wall and pegmatite.

The minerals noticed in these mines were white and blue topaz; pink, green, and white beryl; black, green, and brown tourmaline; spessartite (so called); biotite; magnetite; orthoclase; albite; quartz in fine crystallizations, and the two unknown minerals above referred to.

HERCULES MINE.

BERYL, ESSONITE, AND SPESSARTITE GARNET.

This mine lies about 4½ miles northeast of Ramona and about three-fourths of a mile northwest of the stage station between Fosters and Julian. It was located in August, 1903. Work has been confined to open cuts or scalping, and all the gems have been extracted either from the débris, or from broken pockets in the ledge. This is a coarse pegmatite, decomposed, and with very little perfection in the albite or orthoclase; but where black tourmalines penetrate this crystallization and join the tourmaline embedded in either albite or orthoclase, are essonite garnet and so-called spessartite. The latter is of the finest quality, and has produced flawless gems from 1 to 6 and 8 carats in weight, which retail at $20 a carat. Both hanging and foot walls are a gray diorite, with some mica. The course of the vein is north 60° west, with a dip of 45°. The location is in the SE. ¼ SE. ¼ sec. 6, T. 13 S., R. 2 E., San Bernardino meridian. The product has been handled exclusively by screening, and a good many gems have been thrown over on account of the peculiar condition of the clays which cover them; but the output so far has been 15 pounds of garnet and one-half pound of very clear green beryl, which is associated with it. A few green and blue tourmalines, but not of gem quality, have been found higher up on the ledge. There is a spring on this property, which will furnish water for domestic and mining purposes, also sycamore and oak timber in sufficient quantity.

LOOKOUT MINE.

BERYL AND SPESSARTITE GARNET.

This mine was located in July, 1903. It is situated 4½ miles northeast of Ramona, and joins the Hercules mine on the northeast. The vein has a dip of 20° to the southwest, and an average width of 4½ feet. The claim is 600 by 1,000 feet, runs north 55° west, and is located in the SE. ¼ sec. 5, T. 13 S., R. 2 E., San Bernardino meridian.

Work in this mine has been confined to open cuts and scalping. Spessartite garnet is the only gem found, although indications of beryl and tourmaline, with several peculiar metallic substances not yet determined, were noticed. Both walls are of gray diorite, containing some biotite mica, although a seam of red clay lies between either wall and the ledge itself. The latter consists of feldspar, with very little quartz. In the pockets, albite and orthoclase are the mother of crystallization, and a very peculiar condition of the quartz appears. The crystals seem to have been broken at some time into splinters and then welded together, forming a brecciated mass of quartz with no distinct crystallization. Adhering to this quartz, and also to the surface of the albite, are perfectly formed garnet crystals, many of which have afforded beautiful gems. Not enough work has been done to make a satisfactory examination, but this mine if properly handled should be a paying producer. About 3 pounds of garnet and perhaps 4 ounces of fine beryl are the total product thus far (1904). Some sycamore and oak timber is available, and water on the Hercules mine can be used in connection with this one.

M'FALL MINE.

ESSONITE GARNET AND EPIDOTE.

This mine is situated 7½ miles southwest of Ramona and on the eastern line of the San Vicente grant; it was located about ten years ago as a zinc mine, and erroneous reports were given of its value as a zinc property. On examination, no evidence of zinc was found, but a large body of essonite garnet and finely crystallized epidote were shown. A shaft 21 feet in depth still remains in solid garnet, with very little impurity of quartz. Very few gems were found, however, although many handsome crystals, more or less transparent, have been taken out. But there is some condition in these crystals which does not produce good refraction of light, and hence they have no value as gems. The epidote, however, is the finest yet seen in San Diego County, and will probably produce gems. Mr. McFall expects to work the garnet for abrasive purposes, as transportation can be secured cheap enough to do this profitably. There are both wood and water adjacent to the property, though not on it. No work has been done for some little time, and specimen hunters have taken the finest accessible material. The general formation is blue and gray diorite, and the masses of garnet appear to be pockets rather than ledges.

PROSPECT MINE.

TOURMALINE AND SPESSARTITE GARNET.

The Prospect mine was located on September 15, 1904, and is about 4 miles northwest of Ramona, crossing the road between Ramona and Mesa Grande, an open cut having been made on the east side of the road in the Hatfield Canyon. Spessartite has been the only product in gems, although greenish tourmalines have also been found. The ledge is about 6 feet thick, of a poorly crystallized pegmatite, and most of the gems are found "frozen" into the ledge, few pockets having been discovered. Work is going on, and probably a better condition will be found in 15 or 20 feet from the present working. The output has been small, and no sales have yet been made. The Prospect is worth mentioning, however, as it is the last mine on the northwest end of the Ramona belt of crystallization, the belt apparently being barren for 14 miles northward of Mesa Grande. The owners expect to continue their work until something definite is known of this property, and a report a few months later will be more satisfactory than can be had at present. There are both wood and water in plenty on the property.

THE JACUMBA DISTRICT.

This region is developing indications of much interest. It lies quite near the Mexican line far south of the districts previously considered and on the eastern border of the gneissic and granitic zone of hills and mountains, where the latter fall off steeply toward the desert. The Jacumba Hot Springs are some 70 miles east of the city of San Diego, on the line of a projected railroad. The region, for a considerable distance around, and even out on the desert to the northeast, is rich in garnets, but most of it is wild, inaccessible, and barren. The following are the points thus far opened and definitely reported:

DOS CABEZOS MINE.

ESSONITE GARNET.

This mine is 17 miles north and east from Jacumba Hot Springs by road, although in a direct line only about 8 miles; it is situated in sec. 2, T. 17 S., R. 8 E. Here many hyacinth garnets have been taken out from a matrix of carbonate of lime, which occurs in quantities sufficient to be used as building marble, etc. There are also indications of phosphate of lime superior to that from the Grapevine district in San Diego County. This locality has been worked from time to time for the last ten years for gem crystals, and several hundred dollars' worth have been taken out, but nothing definite has been done, owing to its inaccessibility and to the lack of wood and water. Other properties are now owned in the same vicinity and development is expected during 1905.

——— MINE.

ESSONITE AND SPESSARTITE GARNET.

Nine and one-half miles east of Jacumba and near Mountain Springs, on the road from San Diego to Imperial and on unsurveyed land, is a locality on which several prospects have been located showing excellent essonite and so-called spessartite garnet. A shaft has been sunk and considerable surface work has been done. The gems extracted are of exceptional quality and size. Several thousand dollars will be expended by the owners during 1905. The water supply is about 4½ miles away, and there is no timber whatever or even wood for ordinary purposes. The country is very rough and inaccessible, but bids fair to be one of the best producers of gems yet discovered in California.

CRYSTAL GEM MINE.

BERYL, ESSONITE AND SPESSARTITE GARNET.

This mine is situated about 8½ miles northwest from Jacumba. Pink and green beryls associated with essonite and (so-called) spessartite garnet have been the only output, but general indications are very favorable. The ledge is a coarse pegmatite about 8 feet in width, and extends for nearly a mile. Quartz crystals, albite, orthoclase, and indications of lithia are found associated. The property is not worked at present, but probably will be during 1905. Ten pounds of fine essonite garnet and perhaps 3 or 4 pounds of beryl were taken out during 1904. There is a spring of water on the property and plenty of timber.

MANGANESE DEPOSIT.

GARNET, BERYL, BLACK TOURMALINE.

These deposits lie 1½ miles northwest of Jacumba Hot Springs. A ledge averaging 10 feet in width and extending about 5,000 feet has been located and shows oxides of manganese associated with garnet, beryl, and black tourmaline. No development work has been done, but upon the advent of a railroad this property will be valuable as the manganese is of exceptional quality and can be utilized in many ways.

Farther to the north and east are other localities—in the vicinity of Seventeen Palms, in the Santa Rosa Mountains, on the edge of the desert, and in the direction of Salton Lake, where fine and abundant occurrences of garnet are reported. Much of this is the wild and barren country claimed by an old Indian chief known throughout the region as Fig-tree John.

PRODUCTION.

In the following table is given a statement of the production of precious stones in the United States from 1898 to 1904, inclusive:

Production of precious stones in the United States, 1898–1904.

Stone.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
Diamond	None.	$300	$150	$100	None.	$50	None.
Sapphire	$55,000	68,000	75,000	90,000	$115,000	100,000	$100,000
Ruby	2,000	3,000	3,000	500	None.	None.	None.
Topaz	100	None.	None.	None.	None.	200	None.
Beryl (aquamarine, etc.)	2,200	4,000	11,000	5,000	4,000	4,000	5,000
Beryl (pink)	....	....	....	....	....	200	100
Emerald	50	50	1,000	1,000	1,000	250	None.
Phenacite	None.	None.	None.	None.	None.	None.	None.
Tourmaline	4,000	2,000	3,500	15,000	30,000	45,000	40,000
Peridot	500	500	500	500	500	5,000	5,000
Kunzite	....	....	....	....	....	....	10,000
Quartz, crystal	17,000	12,000	10,000	10,000	12,000	10,000	10,000
Smoky quartz	1,000	None.	1,000	1,000	2,000	1,500	2,000
Rose quartz	100	100	100	150	200	1,500	1,000
Amethyst	250	250	500	500	2,000	3,000	3,000
Prase	None.	None.	None.	None.	None.	None.	None.
Gold quartz	5,000	500	2,000	2,000	3,000	3,000	5,000
Rutilated quartz	100	50	50	50	100	100	None.
Dumortierite in quartz	None.	None.	None.	None.	None.	None.	None.
Tourmalinated quartz	None.	None.	None.	1,000	None.	None.	None.
Agate	1,000	1,000	1,000	1,000	1,000	2,000	2,000
Moss agate	1,000	1,000	1,000	500	500	1,400	1,500
Chrysoprase	100	100	100	1,500	5,000	1,500	6,000
Silicified wood (silicified and opalized)	2,000	3,000	6,000	7,000	7,000	5,000	5,000
Opal	200	None.	None.	None.	150	200	None.
Garnet (almandite)	5,000	5,000	500	100	None.	None.	None.
Rhodolite	None.	None.	20,000	21,000	1,500	1,000	None.
Garnet (pyrope)	2,000	2,000	1,000	1,000	1,000	2,000	3,000
Topazolite	None.	None.	None.	None.	None.	None.	None.
Amazon stone	500	250	250	200	500	400	500
Oligoclase	10	20	20	None.	None.	None.	None.
Moonstone	None.	None.	None.	None.	None.	None.	None.
Turquoise	50,000	72,000	82,000	118,000	130,000	110,000	100,000
Utahlite (compact variscite)	100	100	100	250	None.	100	200
Chlorastrolite	5,000	3,000	3,000	3,000	4,000	3,000	2,000
Mesolite (thomsonite, so called)	1,000	1,000	1,000	1,000	1,000	500	500
Prehnite	100	50	50	None.	None.	None.	None.
Diopside	None.	None.	None.	None.	None.	None.	None.
Epidote	None.	None.	None.	None.	None.	None.	None.
Pyrite	1,000	1,000	2,000	3,000	3,000	3,000	3,000
Malachite	None.	250	200	100	None.	None.	None.
Rutile	110	200	100	None.	None.	None.	None.
Anthracite (ornaments)	1,000	2,000	2,000	2,000	2,000	2,000	2,000
Catlinite (pipestone)	2,000	2,000	2,000	2,000	2,000	2,000	2,500
Fossil coral	500	50	50	100	None.	None.	None.
Arrow points	1,000	1,000	1,000	500	None.	None.	None.
Miscellaneous	....	....	....	....	....	....	15,000
Total	160,920	185,770	233,170	289,050	328,450	321,400	324,300

IMPORTS.

The following table shows the value of the diamonds and other precious stones imported into the United States from 1867 to 1904, inclusive:

Diamonds and other precious stones imported and entered for consumption in the United States, 1867–1904.

Year ending—	Diamonds.					Diamonds and other stones not set.	Set in gold or other metal.	Total.
	Glaziers'.	Dust.	Rough or uncut.	Set.	Unset.			
June 30—								
1867	$906					$1,317,420	$291	$1,318,617
1868	484					1,060,544	1,465	1,062,493
1869	445	$140				1,997,282	23	1,997,890
1870	9,372	71				1,768,324	1,504	1,779,271
1871	976	17				2,349,482	256	2,350,731
1872	2,386	89,707				2,939,155	2,400	3,033,648
1873		40,424	$176,426			2,917,216	326	3,134,392
1874		68,621	144,629			2,158,172	114	2,371,536
1875		32,518	211,920			3,234,319		3,478,757
1876		20,678	186,404			2,409,516	45	2,616,643
1877		45,264	78,033			2,110,215	1,734	2,235,246
1878		36,409	63,270			2,970,469	1,025	3,071,173
1879		18,889	104,158			3,841,335	538	3,964,920
1880		49,360	129,207			6,690,912	765	6,870,244
1881		51,409	233,596			8,320,315	1,307	8,606,627
1882		92,853	449,513			8,377,200	3,205	8,922,771
1883		82,628	443,996			7,598,176	[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
December 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	7,803,066	1,472,328		13,561,588
1901	5,864	831,984	6,592,469	2,654	13,544,326	1,838,055		22,815,352
1902	10,738	798,523	8,221,389	175	13,834,168	1,888,793		24,753,586
1903	10,634	720,150	10,275,800	675	13,022,367	2,494,897		26,524,523
1904	73 054	445,621	10,234,587	559	13,439,023	1,893,969		26,086,813

[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.

PRODUCTION.

The total production of talc and soapstone of all varieties during 1904 was 91,189 short tons, valued at $940,731. As compared with 86,901 short tons, valued at $840,060, in 1903, this is an increase of 4,288 tons in quantity and of $100,671 in value, due partly to a general increase in the production of talc from all States, but principally to the large increase in the production of fibrous talc in New York. In 1903 there had been a large decrease in the production of fibrous talc in New York, as compared with the production of 1902, which was due to long and protracted strikes at some of the paper mills.

PRODUCTION IN ALL STATES EXCLUSIVE OF NEW YORK.

Of the 1904 production, 27,184 short tons, valued at $433,331, were obtained from all the States exclusive of New York. As compared with the 1903 production of 26,671 short tons, valued at $418,460, this is an increase of 513 tons in quantity and of $14,871 in value. The value given above includes that of the manufactured product made from the talc, there being but a small quantity of the product 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 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 1904, inclusive, according to the condition in which it was marketed:

Production of talc and soapstone, 1893–1904.

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.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Rough	3,920	$30,874	2,816	$20,036	2,908	$23,704	1,815	$9,270
Sawed into slabs	225	4,261	436	7,722	2,027	33,800	3,850	64,276
Manufactured articles [a]	12,618	257,146	13,476	412,028	12,219	274,978	11,990	283,373
Ground [b]	11,880	132,607	10,126	85,371	9,517	85,978	9,529	76,412
Total [c]	28,643	424,888	26,854	525,157	26,671	418,460	27,184	433,331

[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 quantity 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 considerable falling off in the amount of rough talc sold in 1904, and a large increase in the amount of sawed talc sold. Over one-half of the rough talc sold was from Pennsylvania, and nearly all of the sawed talc was from Virginia. This quantity of sawed talc is the largest production reported during the last twelve years. The quantity of manufactured articles made in 1904 was a little less than in 1903, with an increase in their value. The quantity of ground talc produced in 1904 was almost identical with that of 1903, but there was a decided decrease in the value. The 1904 production, as reported, only averaged $8.02 per ton, which is $1.01 less than the average price, $9.03 per ton, of the 1903 production, and 41 cents less than the average price, $8.43 per ton, of the 1902 production. In 1904 the value of ground talc varied from $6 to $13 per ton; in 1903 it varied 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.

There were 9 States from which the 1904 production was obtained, and these, together with the number of producers in each, were as follows: California, 1; Georgia, 2; Massachusetts, 1; New Jersey, 1; North Carolina, 5; Pennsylvania, 2; Vermont, 3; Virginia, 2, and Washington, 1, a total of 18 producers. In 1903 the number of producers was 21, divided among 9 States, as follows: California, 1; Georgia, 4; Maryland, 1; Massachusetts, 1; New Jersey, 1; North Carolina, 7; Pennsylvania, 2; Vermont, 2, and Virginia, 2. Maryland reported no production in 1904, but Washington was added to the list of talc-producing States. As there was only 1 producer from 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 1904, and also in 1902 and 1903, and from 1898 to 1901, inclusive:

Production of talc and soapstone in 1904, by States, exclusive of New York.

State.	1904.	
	Quantity.	Value.
	Short tons.	
New Jersey and Pennsylvania	6,233	$35,755
North Carolina and Virginia	17,625	339,928
Massachusetts and Vermont	1,900	44,200
Other States[a]	1,426	13,448
Total	27,184	433,331

[a] California, Washington, and Georgia.

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	7,082	$52,812	5,412	$44,058
Maryland and Virginia	13,221	372,163	13,118	243,552
North Carolina	5,239	88,962	5,330	76,984
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.

Maryland, which was a producer of talc in 1903, did not report any production in 1904. Washington was added to the list of States producing this mineral. Vermont, which again began producing talc in 1903, largely increased its production in 1904, and there was also a decided increase in the production from Virginia. There was, however, a falling-off in the production from all the other States. The most noticeable change was in the decrease in value of the production from the various States.

PRODUCTION IN NEW YORK.

On account of the large production of fibrous talc from New York, which amounts in quantity to nearly double that obtained from all the other States, and, as nearly all of it is used in the manufacture of paper, it is given separately in this report. In 1904 the production of fibrous talc in New York amounted to 64,005 short tons, valued at $507,400, as compared with 60,230 short tons, valued at $421,600, in 1903. This is an increase of 3,775 tons in quantity, and of $85,800 in value. The average price per ton in 1904 was $7.92, as compared with $7 in 1903, and with $8.65 in 1902, an increase of 92 cents per ton over 1903, and a decrease of 73 cents per ton as compared with 1902. 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

Disposition of fibrous talc produced since 1897 in New York—Continued.

Use.	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*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	64,005	$507,400
Total	69,200	483,600	71,100	615,350	60,230	421,600	64,005	507,400

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, 1880–1904.

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	525,157	97,954	1,140,507
1903	60,230	421,600	26,671	418,460	86,901	840,060
1904	64,005	507,400	27,184	433,331	91,189	940,731

IMPORTS.

The importation of talc into the United States has been very irregular, and never amounted to any very large quantity. 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, 1880–1904.

Year.	Quantity.[a]	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	....	$22,807	1893	1,360	$12,825
1881	....	7,331	1894	622	6,815
1882	....	25,641	1895	3,165	26,843
1883	....	14,607	1896	1,966	18,693
1884	....	41,165	1897	796	8,423
1885	....	24,356	1898	761	9,338
1886	....	24,514	1899	254	3,544
1887	....	49,250	1900	79	1,070
1888	24,165	22,446	1901	2,386	27,015
1889	19,229	30,993	1902	2,859	35,366
1890	1,044	1,560	1903	1,791	19,677
1891	81	1,121	1904	3,268	36,370
1892	531	5,546			

[a] Quantity not reported previous to 1888.

CANADIAN PRODUCTION.

There is but little talc produced in Canada, and the product varies widely from year to year in both 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, 1886–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1886	50	$400	1896	410	$1,230
1887	100	800	1897	157	350
1888	140	280	1898	None.	....
1889	195	1,170	1899	450	1,960
1890	917	1,239	1900	420	1,365
1891	None.	....	1901	None.	....
1892	1,374	6,240	1902	689	1,804
1893	717	1,920	1903	688	2,064
1894	916	1,640	1904	840	1,875
1895	475	2,138			

ABRASIVE MATERIALS.

By Joseph Hyde Pratt.

INTRODUCTION.

From year to year there is a noticeable variation in the quantity of the different kinds of abrasives produced, due partly to the replacement of a certain abrasive either by another natural product or by an artificial abrasive. In 1904 the noticeable changes are the decrease in the total value of the production of natural abrasives and the very large increase in the production of artificial abrasives. The only natural abrasives in which there was an increase of production in 1904 over previous years are grindstones, pulpstones, and pumice. Usually where there is a decrease in the domestic production there is an increase in the imports, but the imports were less in 1904 than in 1903. The large increase, however, in the production of artificial abrasives makes the total value of the consumption of abrasive materials greater in 1904 than in any previous year; and thus, in the aggregate, there is a gradual increase in the quantity of abrasive materials utilized each year in the United States, which is the natural outcome of the continuous growth of our manufacturing industries.

There are many kinds of abrasive materials on the market, some of which are natural products and others artificial. These are divided into three 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 (alundum), and adamite.

In some cases only a small part of the production of the above products is actually used as an abrasive material, and in the following report there is included, with the exception of infusorial earth and tripoli, only that portion of the various abrasive materials that is actually used for abrasive purposes. In the case of infusorial earth and tripoli the total production is not large, and it is therefore all included under the head of Abrasive Materials.

In 1904 the aggregate value of the production of the natural abrasive materials was $1,406,851, which is a decrease of $86,452 as compared with $1,493,303, the value of the 1903 production. In the following table are given the values of the different abrasive materials produced in the United States from 1900 to 1904, inclusive:

Value of abrasives produced in the United States during 1900, 1901, 1902, 1903, and 1904.

Kind of abrasive.	1900.	1901.	1902.	1903.	1904.
Oilstones and scythestones	$174,087	$158,300	$221,762	$366,857	$188,985
Grindstones and pulpstones	710,026	580,703	667,431	721,446	881,527
Buhrstones and millstones	32,858	57,179	59,808	52,552	37,338
Pumice			2,750	2,665	5,421
Infusorial earth and tripoli	24,207	52,950	53,244	76,273	44,164
Crystalline quartz	40,705	41,500	84,335	76,908	74,600
Garnet	123,475	158,100	132,820	132,500	117,581
Corundum and emery	102,715	146,040	104,605	64,102	57,235
Total	1,208,073	1,194,772	1,326,755	1,493,303	1,406,851

As is seen from this table, there is considerable variation from year to year in the value of the different abrasives produced and this represents in nearly all cases a corresponding variation in the quantity. There was a large gain in the production of grindstones and pulpstones, and also in the production of pumice. As to all the other abrasives, however, there was a decided decrease, in some cases amounting to nearly 50 per cent, as compared with the 1903 production. As in 1903 there was again a decrease in the value of the prduction of corundum and emery, and the 1904 value is the lowest on record for any year. When, however, the imports of these abrasives and the artificial production of corundum are considered, their consumption in the United States in 1904 was greater than in 1903.

To the value of the natural abrasives should be added the value of the artificial abrasives, which in 1904 was estimated at $830,926, an increase of $337,111 as compared with the estimated value of $493,815 of the 1903 production. The quantity of artificial abrasives, carborundum, crushed steel, and alundum (artificial corundum), produced in the United States since 1900 is given in the following table:

Artificial abrasives produced in the United States during 1900, 1901, 1902, 1903, and 1904.

Kind of abrasive.	1900.	1901.	1902.	1903.	1904.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Carborundum	2,634,900	3,838,175	3,741,500	4,759,890	7,060,380
Crushed steel	700,000	690,000	735,000	755,000	790,000
Alundum (artificial corundum)					4,020,000

The total value of the abrasives used in the United States is still further increased by importation, and in 1904 the total value of the abrasives imported was $547,804, as compared with $621,575 in 1903, a decrease of $73,771. This brings the total value of the abrasive materials consumed in the United States during 1904 to $2,785,581, which is $176,888 more than the value $2,608,693 of the 1903 consumption. There is given in the table following the total estimated value of all the abrasive materials consumed in the United States for the years 1900 to 1904, inclusive:

Total value of all abrasive materials consumed in the United States, 1900–1904.

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	1,493,303	493,815	621,575	2,608,693
1904	1,406,851	830,926	547,804	2,785,581

It is probable that the totals in this table should be reduced by from $75,000 to $100,000 for each year, which would represent the value of the abrasive materials exported from the United States. This table brings out strikingly the constant increase in the total value of the abrasive materials consumed in the United States during the last five years.

There were 26 different States which contributed to the 1904 production of natural abrasive materials, and they are given below in the order of the importance of the value of their respective productions, together with the kind of abrasive mined.

List of States producing abrasives in 1904.

1. Ohio: Grindstones, pulpstones, oilstones, and scythestones.
2. New York: Millstones, infusorial earth, crystalline quartz, garnet, and emery.
3. Michigan: Grindstones.
4. Arkansas: Oilstones.
5. New Hampshire: Scythestones and infusorial earth.
6. Wisconsin: Crystalline quartz.
7. Missouri: Grindstones and infusorial earth.
8. Massachusetts: Infusorial earth and emery.

9. Pennsylvania: Millstones, crystalline quartz, and garnet.
10. Connecticut: Crystalline quartz.
11. Vermont: Scythestones.
12. Indiana: Oilstones.
13. North Carolina: Millstones, garnet, and corundum.
14. Virginia: Millstones and infusorial earth.
15. Maryland: Infusorial earth.
16. Montana: Grindstones and corundum.
17. Nebraska: Pumice.
18. California: Infusorial earth
19. Florida: Infusorial earth.
20. Kentucky: Oilstones and crystalline quartz.
21. Kansas: Emery.
22. South Dakota: Pumice.
23. Wyoming: Grindstones.
24. West Virginia: Grindstones.
25. Georgia: Infusorial earth.
26. Minnesota: Feldspar.

In 1903 there were but 21 States that contributed to the production of abrasive materials, the new States producing in 1904 being Minnesota, South Dakota, West Virginia, Wisconsin, and Wyoming.

OILSTONES AND SCYTHESTONES.

PRODUCTION.

The production of oilstones and scythestones in 1904 was from old localities in Arkansas, Indiana, Kentucky, Ohio, New Hampshire, and Vermont. Michigan, which produced this kind of abrasive material in 1903, made no report of any production in 1904. In New Hampshire and Vermont the material used in manufacturing the oilstones and scythestones is a quartz schist, and in all the other States it is a sandstone, which varies in texture, the novaculite variety being the most valuable of any of the abrasives of this class on the market. Under this head are included all kinds of oilstones, whetstones, water hones, knife sharpeners, and all varieties of razor hones, dental points, etc. There was a large falling off in the production of oilstones and scythestones in the United States in 1904 as compared with the productions of 1902 and 1903. The value of this production in 1904 was $188,985, a decrease of $177,872 as compared with $366,857, the value of the 1903 production; as compared with the 1902 production, the value of which was $221,762, it is a decrease of $32,777. 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 stones instead of the raw material that is given in these statistics.

The value of the Arkansas oilstones was greater than that of any of the States producing this class of abrasive. New Hampshire produced the largest quantity. The States producing oilstones and scythestones in the order of the value of their productions, are as follows: Arkansas, New Hampshire, Ohio, Vermont, Indiana, and Kentucky. There were 11 producers of oilstones and scythestones in these States, as against 18 producers in 1903.

There is given in the following table the value of the oilstones and scythestones produced in the United States from 1891 to 1904, inclusive:

Value of oilstones and whetstones produced in the United States, 1891–1904.

Year.	Value.	Year.	Value.
1891	$150,000	1898	$180,486
1892	146,730	1899	208,283
1893	135,173	1900	174,087
1894	136,873	1901	158,300
1895	155,881	1902	221,762
1896	127,098	1903	366,857
1897	149,970	1904	188,985

From 1880 to 1890, inclusive, the production and value of the rough stones have been published in these reports, except in the case of the output of 1890, when the value of the unfinished product was given for the novaculite of Arkansas, while in all other cases the value of the finished stone 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.

There was also a slight falling off in the value of the imports of oilstones and scythestones during 1904. The value of these imported stones in 1904 amounted to $61,609, as compared with $65,763 in 1903, a decrease of $4,154. The 1904 imports are about one-third the value of the domestic production; in 1903 they were about one-fifth; and the variation that has been noted in the imports of oilstones and whetstones from year to year has, since 1891, ranged in value from one-fifth to one-third as compared with the value of the domestic production. 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, 1880–1904.

Year ending—	Value.	Year ending—	Value.
June 30—		December 31—	
1880	$14,185	1892	$33,420
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	21,434	1897	34,485
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	35,344	1904	61,609

EXPORTS.

There is a considerable demand abroad for American scythestones and oilstones, especially for the New Hampshire scythestones and the Arkansas oilstones. These stones represent the greater part of the stones exported, smaller quantities of the Indiana oilstones being also exported. While there has been no separate record kept of the exports of these stones and no definite valuation can be given, it is not improbable that the exports now exceed the imports in value.

GRINDSTONES AND PULPSTONES.

PRODUCTION.

In 1904 the production of grindstones and pulpstones was confined to Ohio, Michigan, Wyoming, West Virginia, Montana, and Missouri, given in the order of the value of their productions. By far the largest quantity was obtained from Ohio, and this was the only State that produced any pulpstones. The total value of all kinds of grindstones produced in 1904 was $881,527, which is $160,081 greater than the value, $721,446, of the 1903 production. This is the greatest value recorded for the production of grindstones during any year since these statistics were first collected in 1880. This represents a very large increase in tonnage as compared with the earlier productions, for it must be borne in mind in comparing the values of the productions of the earlier years with those of the last few years that the average value per ton for the grindstones which was from about $15 to $18 per ton has decreased to from $8 to $11 per ton, these values not including pulpstones. Thus the actual tonnage of grindstones produced annually in the last five years is greater than for any previous year. Of the total value of the 1904 production the sum of $61,320 is due to pulpstones, an increase of $27,350 as compared with the value $33,970 of the 1903 production, which in turn was an increase of $10,882 over the 1902 value of $23,088. The value of the grindstone production was $820,207, an increase of $132,731 as compared with $687,476, the value of the 1903 production, which in turn was an increase of $43,133 over the value of the 1902 production, $644,343. In the following table is given the value of the production of grindstones and pulpstones for the years 1901 to 1904, inclusive:

Value of the production of grindstones and pulpstones, 1901–1904.

	1901.	1902.	1903.	1904.
Grindstones	$561,903	$644,343	$687,476	$820,207
Pulpstones	18,800	23,088	33,970	61,320
Total	580,703	667,431	721,446	881,527

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 1904 the number of grindstones reported, exclusive of pulpstones, aggregated 53,572 pieces, valued at $652,717, as against 52,383 pieces, valued at $501,500, in 1903. The product reported by weight amounted to 15,755 tons, valued at $167,490, in 1904, as against 16,891 tons, valued at $185,976, in 1903. The average value of that portion of the 1904 product, reported by weight, was $10.63 per ton. The price per ton reported varied from $10 to $18.20.

In the following tables are given the values of the grindstones and pulpstones produced in the United States during 1903 and 1904, and during 1902, by States:

Value of grindstones and pulpstones produced in the United States during 1903 and 1904, by States.

State.	1903.	1904.
Ohio	$646,776	$767,552
Michigan	70,550	112,500
West Virginia, Missouri, and Montana	4,120	[a] 1,475
Total	721,446	881,527

[a] Including a small production from Wyoming in 1904.

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 $120,776 in the value of the Ohio production, and of $41,950 in the value of the Michigan production in 1904 over 1903. The productions of West Virginia, Missouri, Montana, and Wyoming were all small. There were a total of 22 producers of grindstones in 1904, of whom 15 were in Ohio, 3 in Michigan, and 1 each in Missouri, Montana, West Virginia, and Wyoming.

The value of the production of grindstones and pulpstones in the United States from 1880 to 1904, inclusive, is shown in the following table, which illustrates very clearly the depression and the revival of this industry, and consequently of the manufacturing industries of the country during and since the financial depression of 1893 and of the years immediately following:

Value of grindstones produced in the United States, 1880–1904.

Year.	Value.	Year.	Value.
1880	$500,000	1893	$338,787
1881	500,000	1894	223,214
1882	700,000	1895	205,768
1883	600,000	1896	326,826
1884	570,000	1897	368,058
1885	500,000	1898	489,769
1886	250,000	1899	675,586
1887	224,400	1900	710,026
1888	281,800	1901	580,703
1889	439,587	1902	667,431
1890	450,000	1903	721,446
1891	476,113	1904	881,527
1892	272,244		

IMPORTS.

There still continues to be a certain amount of grindstones imported into the United States each year, principally pulpstones, and a few grindstones that are used in the glass and optical trades. These stones are obtained from Newcastle-upon-Tyne, and from Wales, Scotland, and Bavaria. In 1904 the value of the imports of grindstones amounted to $93,152 as against $85,705 in 1903. This is the largest value of grindstones imported since 1883, and represents a larger tonnage than that year on account of the decrease in value of these stones. 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 1883, inclusive, and of the value since 1884:

Grindstones imported and entered for consumption in the United States, 1868–1904.

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	60,935	104,716
1872	1,202	13,453	10,775	100,494	113,947
1873	1,437	17,033	8,377	94,900	111,933
1874	1,443	18,485	7,721	87,525	106,010
1875	1,373	17,642	7,656	90,172	107,814
1876	1,681	20,262	6,079	69,927	90,189
1877	1,245	18,546	4,980	58,575	77,121
1878	1,463	21,688	3,669	46,441	68,129
1879	1,603	24,904	4,584	52,343	77,247
1880	1,573	24,375	4,579	51,899	76,274
1881	2,064	30,288	5,045	56,840	87,128
1882	1,705	30,286	5,946	66,939	97,225
1883	1,755	28,055	6,946	77,797	105,852
1884					[a] 86,286
1885					50,579
December 31—					
1886					39,149
1887					50,312
1888					51,755
1889					57,720
1890					45,115
1891					21,028
1892					61,052
1893					59,569
1894					52,688
1895					54,276
1896					66,195
1897					49,496
1898					62,973
1899					63,852
1900					92,581
1901					88,871
1902					76,906
1903					85,705
1904					93,152

[a] Since 1883 not separately classified.

CANADIAN PRODUCTION.

The production of grindstones in Canada has not as yet become a very important industry, and in 1904 it amounted to only 4,509 tons, valued at $42,782, as against 5,538 tons, valued at $48,302, in 1903. The average price per ton in 1904 was $9.49, as against $8.72 in 1903, this being considerably less than the average price of $10.63 per ton received for the United States production.

BUHRSTONES AND MILLSTONES.

PRODUCTION.

From 1894 up to 1903 there had been a general increase from year to year in the value of the production of buhrstones in the United States, but in 1903 there began a decline in the demand for buhrstones, and the decrease in 1904 was twice what it was in 1903. The total value of the production of buhrstones in 1904 was $37,338, a decrease of $15,214 as compared with $52,552, the value of the production in 1903, which in turn was a decrease of $7,256 as compared with $59,808, the value of the 1902 production. It had been expected that the production of buhrstones in 1904 would exceed that in 1903, as the demand for these stones to be used for grinding mineral paints, barytes, drugs, paste, mustard, cement, plaster, fertilizers, glucose, chocolate, spices, etc., has been steadily growing, and wherever such stones have been used they have for the most part given perfect satisfaction. There are a number of States in which rock of the right texture and quality for manufacturing buhrstones can be obtained. There were, however, only four States having a production of buhrstones or millstones in 1904, with a total of 26 producers, as follows: New York, 17; Pennsylvania, 4; Virginia, 3, and North Carolina, 2. Vermont, which was a producer in 1903, reported nothing in 1904. The following table gives the values of the productions for the years 1902, 1903, and 1904, by States:

Value of buhrstones produced in the United States in 1902, 1903, and 1904, by States.

State.	1902.	1903.	1904.
New York	$39,570	$35,441	$24,585
Virginia	11,435	9,812	4,759
North Carolina and Vermont	6,825	5,902	[a] 6,500
Pennsylvania	1,978	1,397	1,494
Total	59,808	52,552	37,338

[a] No production of buhrstones from Vermont in 1904.

The following table gives the value of buhrstones produced in the United States since 1880:

Value of buhrstones produced in the United States, 1880–1904.

Year.	Value.	Year.	Value.
1880	$200,000	1893	$16,639
1881	150,000	1894	13,887
1882	200,000	1895	22,542
1883	150,000	1896	22,567
1884	150,000	1897	25,932
1885	100,000	1898	25,934
1886	140,000	1899	28,115
1887	100,000	1900	32,858
1888	81,000	1901	57,179
1889	35,155	1902	59,808
1890	23,720	1903	52,552
1891	16,587	1904	37,338
1892	23,417		

IMPORTS.

The value of the imports of buhrstones into the United States varies considerably from year to year, as is shown in the following table, which gives the buhrstones imported since 1868:

Value of buhrstones and millstones imported into the United States, 1868–1904.

Year ending—	Rough.	Made into millstones.	Total.	Year ending—	Rough.	Made into millstones.	Total.
June 30—				December 31—			
1868	$74,224	....	$74,224	1886	$29,273	$662	$29,935
1869	57,942	$2,419	60,361	1887	23,816	191	24,007
1870	58,601	2,297	60,898	1888	36,523	705	37,228
1871	35,406	3,698	39,104	1889	40,432	452	40,884
1872	69,062	5,967	75,029	1890	32,892	1,103	33,995
1873	60,463	8,115	68,578	1891	23,997	42	24,039
1874	36,540	43,170	79,710	1892	33,657	529	34,186
1875	48,068	66,991	115,059	1893	29,532	729	30,261
1876	37,759	46,328	84,087	1894	....	....	*a* 18,087
1877	60,857	23,068	83,925	1895	....	....	*a* 20,316
1878	87,679	1,928	89,607	1896	....	....	*a* 26,965
1879	101,484	5,088	106,572	1897	....	....	*a* 22,956
1880	120,441	4,631	125,072	1898	22,974	1,025	23,999
1881	100,417	3,495	103,912	1899	18,368	513	18,881
1882	103,287	747	104,034	1900	27,960	944	28,904
1883	73,413	272	73,685	1901	40,885	1,302	42,187
1884	45,837	263	46,100	1902	15,243	915	16,158
1885	35,022	455	35,477	1903	21,160	8,481	29,641
				1904	30,117	2,269	32,386

a Not separately classified.

PUMICE.

Nearly all the world's demand for pumice is supplied by a deposit in the northwestern part of the island of Lipari. About 80 per cent of that used in the United States is shipped directly from that island. Although there are extensive deposits of pumice known in the United States, very few of them can compete with the foreign pumice on account of the distance of the deposits from the point of consumption.

PRODUCTION.

The production of pumice in the United States during 1904 was from Nebraska and South Dakota, and amounted to 1,530 tons, valued at $5,421, or $3.54 per ton. This is an increase of 645 tons in quantity and of $2,756 in value as compared with the production of 1903, which amounted to 885 tons, valued at $2,665, or $3.01 per ton. There was also an increase of 53 cents per ton received for the 1904 product, as compared with that received for that of 1903. Nearly all of this production was used in the manufacture of soap and silver polish. There were four producers of pumice in 1904, two each in Nebraska and South Dakota. The South Dakota pumice is obtained from Argyle, Custer County, and the Nebraska product from Orleans, Harlan County. There was also development work carried on at pumice deposits at Rockland, Oneida County, Idaho, by Messrs. Houtz & Warner, and in New Mexico by Messrs. M. P. Stone & Co. The following table gives the production of pumice in the United States for the years 1902 to 1904, inclusive:

Production of pumice in the United States, 1902–1904.

Year.	Quantity.	Value.	Value per ton.
	Short tons.		
1902	700	$2,750	$3.93
1903	885	2,665	3.01
1904	1,530	5,421	3.54

IMPORTS.

The quantity of pumice imported into the United States can not be even approximately given as no record of it is kept by the Department of Commerce and Labor, only the value of the pumice imported being recorded. The importation of pumice is very irregular, sometimes there being enough imported nearly to satisfy the market for the following year, so that during some years there is little or no importation of this abrasive. In 1904 the value of the pumice imported into the United States was $77,211, as against $83,920 in 1903 and $22,448 in 1902.

INFUSORIAL EARTH AND TRIPOLI.

Under this head are included all porous, siliceous earths of organic origin which have been designated as infusorial earth, tripoli, and diatomaceous earth. These are formed from the siliceous shells of diatoms and other microscopic species, and occur in deposits that are often 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 to 10 or more per cent of moisture. Deposits of these earths occur in many of the States on the eastern slopes of the Appalachian Mountains and in a number of the western States and Territories. There are on the market, however, other materials besides that obtained from these deposits, which are sold under the same name, such as ground quartz.

Only a small portion of the infusorial earth is used for abrasive purposes, as in the manufacture of scouring soaps, silver polishes, etc. The more extensive use of this material is in the manufacture of dynamite and in the packing for boilers, steam pipes, and stoves, and as a base for fire and heat-retarding cements. The product obtained from Missouri is principally used in the manufacture of various filtering apparatus.

PRODUCTION.

There was a large decrease in the production of infusorial earth in 1904. The production was 6,274 short tons valued at $44,164—a decrease of 2,945 tons in quantity and of $32,109 in value, as compared with the production of 9,219 short tons valued at $76,273 in 1903. The States from which this production was obtained, given in the order of their production and of the number of producers in each, were as follows: Missouri, 2; Maryland, 1; California, 2; Virginia, 1; Florida, 1; New Hampshire, 1; New York, 1; Massachusetts, 1; Georgia, 1—a total of 11 producers in 9 States.

From year to year there is considerable variation in the quantity and value of the infusorial earth produced in the United States, which is due partly to the substitution of other materials and partly to the production by some companies in one year of a quantity of the raw material sufficient to last a year or two. In the table following is given the quantity and value of infusorial earth produced in the United States since 1880.

Production of infusorial earth, 1880–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	1,833	$45,660	1893	....	$22,582
1881	1,000	10,000	1894	2,584	11,718
1882	1,000	8,000	1895	4,954	20,514
1883	1,000	5,000	1896	3,846	26,792
1884	1,000	5,000	1897	3,833	22,385
1885	1,000	5,000	1898	2,733	16,691
1886	1,200	6,000	1899	3,302	25,302
1887	3,000	15,000	1900	3,615	24,207
1888	1,500	7,500	1901	4,020	52,950
1889	3,466	23,372	1902	5,665	53,244
1890	2,532	50,240	1903	9,219	76,273
1891	....	21,988	1904	6,274	44,164
1892	....	43,655			

IMPORTS.

There is imported into the United States a small quantity of infusorial earth or tripoli, which, however, is not separately recorded, but is included with rotten stone, which is used for similar purposes. The value of the imports of rotten stone and tripoli in 1904 amounted to $23,022, as against $34,977 in 1903 and $39,926 in 1902; no record is kept by the Bureau of Statistics of the number of tons of these materials imported.

CRYSTALLINE QUARTZ.

Only a very small part of the crystalline quartz mined in the United States is included under this head, as only a very small part is used for abrasive purposes, the larger part being used in the brick and pottery, building, and glass industries and as a flux in metallurgical works. The crystalline quartz which is included in this report is used principally as a wood finisher and in the manufacture of sandpaper and of scouring soaps. That used for wood finishing is obtained almost entirely from Connecticut, with a smaller quantity from New York, and that used in the manufacture of sandpaper is obtained largely from Pennsylvania. Besides these uses of quartz there are very large quantities of quartz sand used in the stone-cutting trade, especially by marble dealers in cutting blocks of stone into slabs by means of a gang saw. It is also used in the manufacture of oilstones and scythestones, in reducing the rough blocks of sandstone and schists to the correct size and shape on the rubbing table. There is little or no record kept by those who use sand for this purpose of the quantity they use or its value, and therefore no attempt has been made to include this quartz in this report.

There has been a new locality for quartz recently developed by the M. Chapman Company, of New York City, which is located 27 miles west of Philadelphia, near Bacton, in Chester County, Pa. The material as examined is a variety of quartz somewhat like chert, but of a more crystalline structure; it is not brittle and splintery like ordinary crystalline quartz, but is very tough and hard to break. When crushed, rolled, and reduced to a fine mesh, it stands up very well for abrasive purposes, not going so readily or quickly to an impalpable powder as ordinary crystalline quartz, and it was this hard and tenacious character that led to its being quarried and put on the market for abrasive purposes. The quartz is cleaned when necessary, and is then crushed and pulverized, being first broken to 1½ inches, then to one-half inch, and then fed to rolls, which reduce it to about 4-mesh, after which it is further pulverized. It is being put on the market as "Indurite or White Emery," and for the purposes for which it is used it gives very good satisfaction.

PRODUCTION.

In 1904 the production of crystalline quartz in the United States amounted to 31,924 short tons, valued at $74,600, as against 8,938 short tons, valued at $76,908, in 1903. The reason for the apparently large decrease in value of the 1904 production of quartz as compared with the 1903 is that with the exception of 20 tons, all of the 1904 production reported was of the crude, rough quartz, while of the 1903 production, 8,020 short tons, valued at $71,590, or $8.93 per ton, was a refined product, and only 918 short tons, valued at $5,318, or $5.79 per ton, was sold in the rough. The average value of the 1904 production per ton was $2.33. The large increase in quantity was due to an unprecedented production of quartz in Wisconsin. The 1904 production was obtained from Wisconsin, Connecticut, New York, Pennsylvania, and Kentucky, given in the order of the importance of their productions. In the table following are given the quantity and value of crystalline quartz produced in the United States since 1894:

Production of crystalline quartz, 1894–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1894	6,024	$18,054	1900	14,461	$40,705
1895	9,000	27,000	1901	14,050	41,500
1896	6,000	18,000	1902	15,104	84,335
1897	7,500	22,500	1903	8,938	76,908
1898	8,312	23,990	1904	31,924	74,600
1899	13,600	39,000			

GARNET.

PRODUCTION.

The production of abrasive garnet in the United States during 1904 amounted to 3,854 short tons, valued at $117,581, as compared with 3,950 short tons, valued at $132,500, in 1903, a decrease of 96 short tons in quantity and of $14,919 in value, due to the smaller production of North Carolina corundum, such as has formerly been mined at the Sugar Loaf mine of Jackson County and put on the market as "ruby corundum." The average price of the 1904 production was $30.51 per ton as against $33.54, the average price per ton of the 1903 production. The 1904 production of garnet was obtained from New York, Pennsylvania, and North Carolina, given in the order of the importance of their productions.

In the following table are given the quantity and value of the abrasive garnet produced in the United States since 1894:

Production of abrasive garnet, 1894–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1894	2,401	$90,660	1900	3,185	$123,475
1895	3,325	95,050	1901	4,444	158,100
1896	2,686	68,877	1902	3,926	132,820
1897	2,554	80,853	1903	3,950	132,500
1898	2,967	86,850	1904	3,854	117,581
1899	2,765	98,325			

Previous to 1900 a certain portion of the North Carolina product was not included in the garnet statistics, and this will account to some extent for the decided increase in the production since that year, for in reality there has been a close agreement in the quantities of garnet produced from year to year.

CORUNDUM AND EMERY.

PRODUCTION.

Although the demand for corundum and emery has been constantly increasing from year to year, this demand has not been met by a domestic production of these abrasive materials, but by the importation of foreign emeries and corundums and by the manufacture of artificial corundum. Since the discovery of the Canadian corundum deposits there has been a constant falling off in the production of corundum and emery in the United States, notwithstanding the discovery of the deposits in Montana. North Carolina and Georgia, which were the first States in this country to produce corundum and which for many years produced all of the corundum used in the United States (emery being excepted), furnished but little of the 1904 production. This production amounted to only 1,932 short tons, valued at $57,235, as compared with 2,542 short tons, valued at $64,102, in 1903, a decrease of 610 short tons in quantity and of $6,867 in value. A small part of this production was due to corundum obtained from Montana and North Carolina. The emery was obtained principally from New York and Massachusetts, with a small quantity reported from Kansas. Whereas formerly the Chester, Mass., deposits largely exceeded the production of the Peekskill, N. Y., deposits, the reverse is now true, and the production of the latter State is nearly three times that of the former.

The following table gives the total quantity and value of the corundum and emery produced in the United States since 1880:

Annual production of corundum and emery, 1881–1904.

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	1904	[a] 1,932	57,235

[a] Includes a small quantity of feldspar produced in Minnesota; see Feldspar.

IMPORTS.

There continue to be imported into the United States emery and corundum largely in excess of the home production, and in 1904 these imports were valued at $260,424 as against $321,569, the value of the 1903 imports. The following table shows the quantity and value of emery and corundum imported into the United States from 1867 to 1904, inclusive.

Emery and corundum imported into the United States, 1867–1904.

Year ending—	Grains.		Ore and 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	61,653
1877	343,697	16,615	852	21,964	96,351	3,603		42,182
1878	334,291	16,359	1,475	38,454	65,068	1,754	34	56,601
1879	496,633	24,456	2,478	58,065	133,566	4,985		87,506
1880	411,340	20,066	3,400	76,481	223,855	9,202	145	105,894
1881	454,790	22,101	2,884	67,781	177,174	7,497	53	97,432
1882	520,214	25,314	2,765	69,432	117,008	3,708	241	98,695
1883	474,105	22,767	2,447	59,282	93,010	3,172	269	85,490
1884	143,267	5,802	4,145	121,719	513,161	21,181	188	148,890
1885	228,329	9,886	2,445	55,368	194,314	8,789	757	74,800
December 31—								
1886	161,297	6,910	3,782	88,925	365,947	24,952	851	121,638
1887	367,239	14,290	2,078	45,033	[a]144,380	6,796	2,090	68,209
1888	430,397	16,216	5,175	93,287			8,743	118,246
1889	503,347	18,937	5,234	88,727			111,302	218,966
1890	534,968	20,382	3,867	97,939			5,046	123,367
1891	90,658	3,729	2,530	67,573				71,302
1892	566,448	22,586	5,280	95,625			2,412	120,623
1893	516,953	20,073	5,066	103,875			3,819	127,767
1894	597,713	18,645	2,804	51,487			1,841	71,973
1895	678,761	25,066	6,803	80,386			27,586	133,038
1896	755,693	28,493	6,389	119,738				148,231
1897	539,176	20,665	5,213	107,655			2,211	130,531
1898	577,655	23,320	5,547	106,269			3,810	133,399
1899	728,299	29,124	7,435	116,493			11,514	157,131
1900	661,482	26,520	11,392	202,980			10,006	239,506
1901	1,086,729	43,217	12,441	240,856			10,926	294,999
1902	1,665,737	49,107	7,157	151,959			13,776	214,842
1903	3,595,239	109,272	10,884	[b]194,468			17,829	321,569
1904	2,281,193	109,772	7,054	[c]138,931			11,721	260,424

[a] To June 30 only; since classed with grains. [b] Including emery rock valued at $5,488.
[c] Including emery rock valued at $7,338.

CANADIAN CORUNDUM.

The production of Canadian corundum in 1904 amounted to 919 short tons, valued at $101,050, as compared with 916 short tons, valued at $92,940, in 1903, an increase of 3 tons in amount and of $8,110 in value. Over two-thirds of this production was shipped to the United States. The corundum mill of the Canada Corundum Company, which is the largest producer of Canadian corundum, has been greatly increased during the last year, and the company expects to increase its production largely during 1905. Because of improved machinery, it has reduced the price of corundum to from $4\frac{1}{2}$ to $5\frac{1}{2}$ cents per pound, thus making it a stronger competitor of emery than ever before. With this reduction in price, this corundum should be able to compete with emery and to replace much of the emery that is now being used.

In the following table are given the quantity and value of the production of Canadian corundum for the years 1901 to 1904, inclusive:

Production of Canadian corundum, 1901–1904.

Year.	Quantity.	Value.
	Short tons.	
1901	434	$47,740
1902	805	88,616
1903	916	92,940
1904	919	101,050

FELDSPAR.

There was a very small production of feldspar from the Minnesota locality which was opened several years ago when the feldspar was supposed to be corundum. It is doubtful whether a sufficient use can be made of this feldspar as an abrasive to warrant any large expenditure in developing these properties. The production is included under that of corundum.

ARTIFICIAL ABRASIVES.

The abrasive materials included under this head are carborundum, crushed steel, alundum (artificial corundum), and adamite. Of these artificial abrasives, carborundum and alundum are manufactured in the largest quantity and are of the greatest value. The total production of these artificial abrasives in 1904 amounted to 11,870,380 pounds, valued at $830,926, or over one-half the value of the production of natural abrasives, which was $1,406,851.

CARBORUNDUM.

PRODUCTION.

The production of carborundum in 1904 amounted to 7,060,380 pounds, an increase of 2,300,490 pounds, as compared with the production of 4,759,890 pounds in 1903. This is the largest production in any year since the beginning of the manufacture of this abrasive and illustrates the increasing demand for it. With the exception of one year, 1902, there has been a continual increase from year to year in the production and use of carborundum, and in that year the decrease was due to a scarcity of supplies used in the manufacture of the carborundum. This increase in the production and use of carborundum is well brought out in the following table, which gives its production since 1892, when it was first put on the market. Its value now varies from 8 to 10 cents per pound.

Production of carborundum, 1892–1904.

Year.	Quantity.	Year.	Quantity.
	Pounds.		*Pounds.*
1892	1,000	1899	1,741,245
1893	15,200	1900	2,634,900
1894	52,200	1901	3,838,175
1895	226,000	1902	3,741,500
1896	1,207,800	1903	4,759,890
1897	1,256,400	1904	7,060,380
1898	1,447,200		

CRUSHED STEEL.

PRODUCTION.

The production of crushed steel in 1904 amounted to 790,000 pounds, valued at $55,300, which is the greatest production in any year since this abrasive was first put on the market. As compared with the production of 755,000 pounds in 1903, it is an increase of 35,000 pounds. The average value per pound of crushed steel is 7 cents, the prices of the different grades varying from 5½ to 10 cents per pound. In the following table is given the quantity of crushed steel produced each year since 1898:

Production of crushed steel in the United States, 1898–1904.

Year.	Quantity.	Year.	Quantity.
	Pounds.		*Pounds.*
1898	660,000	1902	735,000
1899	675,000	1903	755,000
1900	700,000	1904	790,000
1901	690,000		

ALUNDUM (ARTIFICIAL CORUNDUM).

The manufacture of artificial corundum from a bauxite which has been developed and put on a commercial basis by the Norton Emery Wheel Company, of Worcester, Mass., at their plant at Niagara Falls, N. Y., has met with great success, and this abrasive, which is known commercially as alundum, is giving most satisfactory results. The greater part of this material produced by the Norton Emery Wheel Company is used by the company itself in the manufacture of its various emery wheels, stones, etc. It makes a clean, fast-cutting abrasive, being nearly absolutely free from any kind of impurity, and has proved its excellent qualities in actual use.

There is another artificial corundum that is being used as an abrasive, but it is only obtained in small quantity, as it represents a by-product in the Goldschmidt Thermit process of the reduction of many of the metals. At the present time none of this corundum is made or put on the market in this country, but at the German factories where the Goldschmidt Thermit process is employed it is utilized as an abrasive.

It is interesting to note the different colors of this corundum, according to the metal that has been prepared. Thus, in the reduction of the mineral chromite to metallic chromium, the corundum, which is the slag that remains, is of a ruby-red color, sometimes the crystallized portion being perfectly transparent; the nickel ores give a blue to bluish gray colored corundum; the manganese ores give a light, intense yellow to greenish-yellow corundum; and the titanium ores give a brownish to brownish-black corundum. The corundum obtained in this way is very pure, but somewhat different in texture and appearance from the corundum obtained by the reduction of bauxite by the Norton Emery Wheel Company, inasmuch as the latter shows little or no parting planes developed and breaks with an irregular fracture, while the former sometimes shows the parting planes well developed and at other times breaks with an irregular fracture.

PRODUCTION.

In 1904 there were 4,020,000 pounds of alundum manufactured, only a small portion of it being put on the market in the crude form; it was sold at an average price of 7 cents per pound.

ADAMITE.

This abrasive, which is a German manufactured product, is used but little in this country, and no report could be obtained of the actual quantity imported.

BORAX.

By Charles G. Yale.

INTRODUCTION.

Although the entire production of borax in the United States is derived from the State of California, there are several borax fields in the desert regions of Nevada and in Oregon which have not of late been exploited. The so-called "dry lake" or desert region of California continues to be the source of the borax supply of the United States. In Harney County, Oreg., the Rose Valley Borax Company owns certain deposits in the marsh lands, but the mines have of late been idle. At Chetco, Curry County, in the same State, is another deposit of borate of lime, but no work has been done on it for several years. No work is being done on the known deposits in Nevada for the reason that the mines in California may be more cheaply operated.

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 Mr. 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 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.

All the output of borax in the United States continues to come from California, and the larger proportion from the extensive colemanite deposits in San Bernardino County. The total product for the year 1904 amounted to 45,647 tons crude, valued at $698,810. Of this amount 38,000 tons, valued at $508,000, came from San Bernardino County, Cal., the remainder coming from Ventura and Inyo counties. In 1903 the returns gave an aggregate production of crude 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.

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.

In the process of manufacturing borax and boracic acid, 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-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. 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 and 1904 is that of the crude material and the value is the "spot"

[a] Bailey, G. E., The saline deposits of California: Bul. California State Mining Bureau No. 24, 1902. Campbell, M. R., Reconnaissance of the borax deposits of Death Valley and Mohave Desert: Bul. U. S. Geol. Survey No. 200, 1902.

value at the mines, though this shows an apparent but not a real falling off in aggregate value from the years preceding.

The statistics of production of borax in California from 1895 to 1904, inclusive, are given in the following table:

Production of borax in California, 1895–1904.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1895	5,959	$595,900	1900	25,837	$1,013,251
1896	6,754	675,400	1901	23,231	1,012,118
1897	8,000	1,080,000	1902	[a] 20,004	2,538,614
1898	8,000	1,120,000	1903	[b] 34,430	661,400
1899	20,357	1,139,882	1904	[b] 45,647	698,810

[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 1904, inclusive:

Imports of borax and borates into the United States, 1867–1904.

[Pounds.]

Year.	Borax.		Borates, calcium, and sodium (crude and refined sodium borate).		Boric acid.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1867	49,652	$6,601	5,672	$711	770,756	73,396
1868	79,183	10,127	22,293	2,985	243,993	22,845
1869	89,695	12,799	54,822	8,011	998,033	109,974
1870	97,078	14,511	2,616	322	1,166,145	173,806
1871	134,927	20,705	5	1	1,204,049	185,477
1872	35,542	6,288	22,500	8,000	1,103,974	191,575
1873	9,284	2,152	Nil.	Nil.	1,222,006	255,186
1874	3,860	1,253	Nil.	Nil.	233,955	52,752
1875	5,153	1,224	588	78	41,742	6,280
1876	3,145	691	Nil.	Nil.	137,518	15,771
1877	3,500	676	55	12	107,468	11,231
1878	3,492	514	286	61	22,839	651
1879	3,472	490	Nil.	Nil.	306,462	21,888
1880	15,278	2,011	22,122	742	243,723	18,473
1881	4,136	865	Nil.	Nil.	187,058	15,771
1882	10,664	3,062	Nil.	Nil.	536,335	71,343
1883	5,611	1,359	Nil.	Nil.	4,334,432	580,171
1884	7,332	1,691	142	34	44,512	4,494
1885	240	41	Nil.	Nil.	48,517	4,035
1886			4	1	430,655	26,238
1887			33	4	376,184	19,885
1888			455	38	487,777	26,394
1889			Nil.	Nil.	676,736	36,814
1890			29,608	800	867,802	43,967
1891			414,151	17,681	666,765	41,019

Imports of borax and borates into the United States, 1867–1904—Continued.

Year.	Borax.		Borates, calcium, and sodium (crude and refined sodium borate).		Boric acid.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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
1904	153,952	10,569	89,447	6,630	708,815	27,658

WORLD'S PRODUCTION.

The following table gives the production of borax and boron compounds in the principal countries of the world from 1896 to 1903, inclusive:

The world's production of borates, etc., 1896–1903.[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	26,387	....	13,177	224	232	2,491	7,080	(d)
1901	30,771	3,065	11,547	162	184	2,558	4,156	(d)
1902	49,725	593	14,327	(e)	196	[f]2,763	5,055	(h)
1903	31,235	1,206	[g]15,734	....	159	2,583	[e]2,584	(h)

[a] From official reports.
[b] Exports.
[c] Fiscal years.
[d] Total exports 1897–1901 amounted to 43,851 tons, valued at £789,318.
[e] Incomplete.
[f] In addition, 375 tons refined borax and 238 tons refined boric acid, all from 12 mines in Province of Pisa.
[g] Includes 2 tons of borax.
[h] Annual output estimated at about 9,000 metric tons.

REVIEW OF THE BORAX INDUSTRY DURING 1904.

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 owned by the Frazier Borate Mining Company, controlled by the Stauffer Chemical Company, of San Francisco. The colemanite 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. The Columbus Borax Company also owns a deposit near Griffin, Ventura County, which began to be productive in 1904. This company does not refine its own product.

San Bernardino County.—In the section around Daggett and Borate, San Bernardino County, several deposits are being worked. The principal of these are those of the Borax Consolidated (Limited), or old Pacific Coast Borax Company, and of the American Borax 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. However, the so-called "mud deposits" are becoming more and more productive every year.

The main deposit of the Borax Consolidated (Limited), known as the "Calico deposit," is that from which by far the largest portion of the product of the United States is derived. This deposit is not found in well-defined ledges, but 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. 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 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 calcined 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. The mine is considered to be in excellent shape as a producer for years to come, though there are unfounded rumors to the contrary. At Daggett the company is running its roaster to full capacity, though it has never hitherto run to more than half the capacity since its installation.

The American Borax Company, at Daggett, is next in importance in point of annual production to the Borax Consolidated. The works are at Daggett and are connected by rail with the mine 7 miles distant. The ore is a borate of lime, varying in boric acid contents from 7 to 30 per cent, and is treated by a special process invented by Mr. Henry Blumenberg, jr. The resultant material is shipped to the Brighton Chemical Company, New Brighton, Pa., and is there converted into borax and refined boric acid. This company has encouraged others owning low grade properties in that section, and doubtless other properties will be developed. It is stated that the company now has ore blocked out to last for fifty years. It is now producing from these low grade ores a carload of boric acid every five or six days.

The Columbus Borax Company owns a mine 5 miles south of Daggett, but is at present only operating the deposit it owns in Ventura County.

The mines of the Palm Borate Company (formerly the American Board of Promotors Boracic Acid Company) are 6½ miles from Daggett. The property is being developed, but no crude ore was sold in 1904. The plant will be in operation by the end of 1905. The company owns 6 patented claims, on all of which more or less work has been done. The ore is a borate of lime in a clay formation. The boric acid was probably formed in the bed of a lake and tilted up during some upheaval of the earth's surface.

Inyo County.—The Western Borax Company owns a deposit near Big Pine, where borax is being produced from marsh dirt or mud containing from 8 to 10 per cent of borax. All the product is the result of concentrating and crystallizing the borax, which is found mixed with large quantities of earth.

In Death Valley, in the same county, are large deposits controlled by the Borax Consolidated (Limited). Very little work has been done on them comparatively, as they are being held in reserve. The deposit in Ash Meadows has been developed in case of failure of the mines at Daggett, and will shortly be connected by rail with a transcontinental railroad.

There are small deposits and prospects of borax along the Mohave Desert and adjoining the Death Valley region, but most of them are of low grade. Doubtless some of them will be utilized before very long, however, as the advance made in the utilization of low-grade ores or muds within the last few years has been surprising, to say the least. Three years ago working these ores was supposed to be impossible, but now large quantities of boric acid are derived from them in San Bernardino and Inyo counties. These low-grade deposits, so long overlooked by the companies controlling the richer deposits, will from this time on become a factor in the annual production.

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 semirefined 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 semirefined 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.

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 barates 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 Bernandino County, Cal., the ores that are not shipped without preliminary calcination are taken by the Borax Consolidated (Limited) to their concentrating plant at Marion, about 6 miles from their mines, 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.

Blumenberg process.—The American Borax Company at Daggett uses the process devised by Henry Blumenberg, jr. His patented mechanical sulphur burner was described in this report for the year 1903. The ore treated is a blue mud, almost hardened into a shale, that was once deposited in the bottom of an ancient lake. These muds are bluish or grayish in color and no borate mineral is visible to the eye. The muds, however, are impregnated with borates of lime and carry from 4 to 20 per cent, the average being about 7 per cent. These beds have been tilted into nearly a vertical shape by geological disturbances. The ore is mined by the same methods used in silver and gold mining. The material as it comes from the mines is perfectly dry, and in this condition is taken to the works, where it is treated as follows:

The ore is first crushed with a rock breaker and then broken by a Chili mill into fragments about the size of a kernel of corn. It is then conveyed into huge vats about 10 feet in diameter by 30 feet high. At the foot of each vat is an iron muffle, of the shape of a heavy cylinder, with air-tight doors. Sulphur is placed in this muffle and, after it has become ignited, air is forced into the muffle, assisting the combustion of the sulphur. The fumes of burning sulphur and the hot air enter the vats at a pressure of about 9 pounds to the square inch. The regularity of this pressure is all important, as the air must combine with the sulphur so as to form sulphurous acid. It must have sufficient pressure to penetrate the mass of pulp steadily, but not so fast as to pass on to the top without the necessary chemical reaction taking place. By the time the sulphur fumes reach the top of the vat the work in that vat is done. The ore from the vats is leached into large evaporating tanks, built in the ground out of doors. These tanks are shallow, similar to those used in salt making. The bottoms are made of cement and are lined with asphalt. The tanks are arranged in series, so that as soon as one is nearly full it overflows into the adjoining one, and so on through the series. Evaporation takes place rapidly in these outdoor tanks, owing to the hot sun, the rapidly moving winds, and the dry air of the desert. In order to hasten the work, however, evaporators are used. These consist of wooden structures about 30 feet high, built of lumber, the various floors being about 1 foot apart. Windmills are placed on top and these pump the water out on the surface of the boards, where it trickles down slowly back to the vats. It has been found that the amount of water evaporated by these structures depends upon the velocity of the wind rather than upon the temperature of the atmosphere.

By the time that the liquid has reached the last of the series of tanks and has passed through the evaporator, it has become so condensed that crystals of boric acid settle to the bottom of the tanks. When the crystals of boric acid have accumulated sufficiently on the bottoms of the tanks, Mexicans, wearing rubber boots, wade in the tanks and push the accumulated crystals up into piles along the edges of the tanks. The crystals are then shoveled in long rows on to the roadways between the tanks, where they are allowed to drain and dry. The crystals of boric acid, when dry, are packed in cases and shipped east.

The chemistry of the process is as follows: The sulphurous acid formed by the heated air and burning sulphur penetrates the mud and breaks up the borate of lime which it contains into boric acid and sulphide of lime. This sulphide of lime would not be formed if the material were exposed to the sun; but is formed in the darkness of the vats and is dissolved in the waters added to leach the material out into the first evaporating tanks. On entering the first tank the liquors have a dark, muddy appearance, but as the liquors are passed from one vat to the other they become clearer and clearer until, by the time they are pumped on top of the evaporators, they are as clear as pure water. Sunlight effects a chemical change in the liquors in the first tanks. It precipitates the sulphide of lime as a dark sediment, while the boric acid remains in solution unaffected. Hence the liquor in the last series of tanks is wholly a solution of crude boric acid, and when it is evaporated nothing but the crystals of crude boric acid is left. The material produced by this process is about 85 per cent pure, the rest consisting of water, magnesium, lime, etc.

Before this process was perfected the method at Daggett consisted of boiling the muds with sulphur and steam. By this process sulphuric acid was formed instead of sulphurous acid. The borate of lime was broken up into boric acid and sulphate of lime (gypsum); the sulphate of lime being insoluble remained in the tanks, and the liquor drained off contained boric acid. While this process made boric acid, the difficulty was that it also made sulphates of magnesia and other minerals, which came off in solution with the acid, injuring its purity and making it more difficult to refine. In the process now used the sulphurous acid has a greater affinity for the borate of lime than for the other minerals, and if the process is stopped at the right time in the vats, the other minerals are not attacked to any extent. The fact that the sulphide of lime dissolves out with the boric acid and is precipitated by the chemical action of the sun in the tanks, enables the material to be thoroughly washed, and does away with the use of the filter presses which were necessary under the old process.

The sulphur used is imported from Japan, as it has been found impossible to get any in the United States as cheap as this can be imported. This sulphur is free from arsenic, a very objectionable mineral. The plant at Daggett cost about $250,000, which includes buildings, tanks, evaporators, windmills, ore crushers, sulphur muffles, engines, air compressors, two gasoline hoists at the mine, railroad, and the cost of two shafts about 700 feet deep.

While the process is not complicated or difficult of control, the works require the constant services of a chemist and two assistants. Crude oil is used for fuel in the engines, and costs $1.27 per barrel, delivered, which is equivalent to soft coal at $5 per ton. The labor in the mill runs night and day, but the force is small. An engineer, a man at the mill, a man at the vats, and two laborers do the work. Labor is used outside only in the daytime. One engineer, who is his own fireman, handles the train back and forth from the mine. Four Mexicans attend to the gathering of the boric crystals. The number of men at the mine varies.

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.

The Palm Borate Company, in treating the ore, destroys the small quantity of lime combined with the boric acid by the use of sulphuric or sulphurous acid. The method of treating ore is burning sulphur under pressure of air and driving the fumes to the bottom of large redwood tanks (20,000 gallons capacity), in which is the pulverized ore mixed with water, undergoing a slow agitation. This makes a weak solution of acid that quickly destroys the lime and by the slow agitation helps to destroy the boric acid in the water. Afterwards the ore is allowed to settle, and when the water is clear it is drawn off into evaporators, and allowed to evaporate in the sun and air. By the use of a large framework a very large surface of water can be exposed to the atmosphere.

Other processes for the manufacture of boric acid from colemanite have been described in previous reports. These include the Moore process, hydrochloric-acid process, sulphuric-acid process, Bigott process, and Blumenberg process.

BROMINE.

By Frederick J. H. Merrill.

The bromine industry of the United States, which has assumed commercial proportions sufficiently large to make an impression on the European market, is based chiefly on salt brines in Michigan, Ohio, and West Virginia.

Although the great deposits of haloid salts at Stassfurt and Leopoldshall in Germany are capable of supplying an almost unlimited market, it has remained for the superior activity of American manufacturers to attempt to overcome the differences in conditions of production and to compete in England, France, and Germany with the Continental product. As a result of this, the German manufacturers have felt obliged to retaliate by offering their goods in America at a price far below that usually current. Hence the price of bromide of potassium has fallen from 25 cents to 15 cents per pound.

Bromine appears in nature combined with various metals forming the minerals embolite, bromyrite, and iodobromite; but none of these are commercial sources of bromine, which is in America derived chiefly from salt brines.

Sea water contains about 0.06 gram per liter of bromine. At Stassfurt and Leopoldshall, in Germany, the mother liquor from the processes of extracting the commercial salts contains from 15 to 35 per cent of bromine.

Through some chemico-geological incident bromine appears in very small quantities in the brines of New York State, so that its production is limited to those areas in which the brines contain it in quantities sufficient for commercial purposes. Michigan, West Virginia, Ohio, and Pennsylvania are the chief producing States in America.

The manufacture of bromine was first begun in 1846 at Freeport, Pa., but has subsequently been chiefly conducted in certain areas of brine production, which are mainly at or near St. Louis, Mich., Pomeroy, Ohio, and Malden, W. Va.

The method of producing bromine is to treat with sulphuric acid the residual liquids or bitterns from the processes of salt manufacture, thus forming hydrobromic acid, and, from this, to separate the bromine by the use of an oxidizing agent which removes the hydrogen. For this purpose either chlorate of potash or binoxide of manganese are used.

In the United States, in order to extract the bromine, the mother liquor is mixed with dilute sulphuric acid which liberates hydrobromic and hydrochloric acids. The mixture is then heated to a temperature of 120° F., thus separating the volatile hydrochloric acid from the hydrobromic acid, which remains in solution. On cooling, various sulphates separate out in crystals. The acid liquor is then distilled with sesquioxide of manganese and sulphuric acid. The distillate passes into two receivers: the first is empty and receives water, bromine, bromoform, bromine chloride, and carbon bromide; the second contains a solution of caustic soda into which the bromine vapors pass and dissolve as bromide and bromate of sodium. This solution is then evaporated and the residue is ignited, after which it is distilled with sulphuric acid and pyrolusite and yields pure bromine, which is collected and preserved under concentrated sulphuric acid. This is the process in ordinary use in the United States.

The process at Stassfurt is slightly different, the mother liquor being directly distilled with pyrolusite and sulphuric acid. This is known as "Frank's process."

The bromine produced in these ways is used by manufacturing chemists, who make from it the bromides of potassium, sodium, and ammonium used for medicinal purposes and as photographic reagents. A small amount of bromine is also used in the preparation of the coal tar colors known as "Eosine" and Hoffman's blue. It is employed also as a chemical reagent for precipitating manganese from acetic acid solution, for the conversion of arsenious into arsenic acid, and for detecting nickel in the presence of cobalt in a potassium cyanide solution. Bromine may also be used as a disinfectant, when dissolved in water.

Interesting metallurgical results have been obtained from its use in the bromination and bromocyanide processes of gold extraction, which may, in a measure, become substitutes for chlorination and cyanidation.

The production of American bromine has varied greatly during the last twenty-five years. In 1880, the total output amounted to 404,690 pounds; in 1885, the quantity was 320,000 pounds; in 1886, it was quoted at 428,334 pounds; it fell to 199,087 pounds in 1887; but with these variations the total output for the twenty-five years has amounted to 10,499,625 pounds, valued approximately at $2,887,917. For 1904, the total output amounted to 897,100 pounds, valued at $269,130.

Germany furnishes annually about 300 tons of bromine.

FLUORSPAR AND CRYOLITE.

By Joseph Hyde Pratt.

FLUORSPAR.

OCCURRENCE.

The uses of fluorspar in foundry work and in steel making have largely increased the demand for this mineral, but notwithstanding the increased demand there have been no new deposits opened during the last year or two, and Illinois and Kentucky still continue to be the chief sources of supply of this mineral. There has recently been published a report on Lead, Zinc, and Fluorspar in Western Kentucky, by Messrs. E. O. Ulrich and W. S. Tangier Smith.[a] The deposits in which the fluorspar is found are in Livingston, Crittenden, and Caldwell, and in adjacent portions of Christian, Trigg, and Lyon counties in the western part of Kentucky, with by far the most of the commercial deposits in Crittenden, Livingston, and Caldwell counties. Crittenden County contains the largest number of productive veins and is at the present time the largest producer of fluorspar in this State. This district is usually considered a minor division of the lead and zinc districts of the Mississippi Valley, but it differs from the other districts chiefly in the presence of basic, igneous dikes, in the abundance of fluorite and its almost constant association with the lead and zinc ores, and in the mode of occurrence of these ores, which are for the most part in true fissure veins. These veins have resulted from fracturing and subsequent faulting. The minerals forming the ore deposits are galena, cerussite, pyromorphite, sulphur, sphalerite, smithsonite, hydrozincite, calamine, greenockite, chalcopyrite, malachite, fluorite, barite, calcite, quartz, kaolinite, and anchorite.

Of the above minerals, those that have been found in sufficient quantity to be of economic importance are fluorite, barite, galena, sphalerite, and smithsonite. In most cases it is the fluorspar that is the chief mineral mined, with the lead and zinc compounds obtained as by-products. In many instances the latter are only in very small

[a] Ulrich, E. O., and Smith, W. S. T., Lead, zinc, and fluorspar in western Kentucky: Prof. Paper U. S. Geol. Survey No. 36, 1905.

quantity, and can be considered simply as impurities in the fluorspar. In most of the mines that are now operated the ore is still being taken from the oxidized zone, and much of it has to be cleaned before it is ready for shipment. Undoubtedly with greater depth the veins will become more clearly defined and the ores will be cleaner. With better transportation and shipping facilities this district should greatly increase its output, as the demand for fluorspar will increase if it can be shipped at reasonable rates.

The Illinois deposits have also recently been described by Mr. H. Foster Bain, of the United States Geological Survey.[a] These deposits are in Pope and Hardin counties, in the extreme southern portion of Illinois.

The principal mines are near Rosiclaire, Elizabethtown, and Cave-in-Rock, small towns on the Ohio River. This area forms the northern part of the Kentucky-Illinois district mentioned above, and the deposits of fluorspar are similar in their occurrence to those in Kentucky. They have been formed along faulting fissures, the principal vein material consisting of fluorspar and calcite. Associated with these are smaller quantities of galena and sphalerite, with occasional traces of other sulphides, notably those containing copper and antimony. In this district fluorspar is the only mineral that is now being mined. According to his report, Mr. Bain believes that the ores will prove permanent in depth to horizons below which it will not be possible to work them profitably on account of the present low value of the ore. He estimates that this feature will in most cases prevent their being worked to a depth greater than 1,000 feet.

USES.

The uses of fluorspar have been described in previous reports, and they are simply mentioned here. The mineral is graded and prepared for market according to the purpose for which it is to be used. Thus, the highest grade and purest fluorspar, which does not contain over 1 per cent of silica and is pure white in color, is used in the glass trade for enameling and in the manufacture of chemical compounds of fluorine. For these purposes the mineral is sold either ground or in lump. The next grade of fluorspar, which has as much as 4 per cent silica and includes the colored fluorspar, is used in the manufacture of steel on account of the great fluidity which it gives to the slag in open-hearth work. This is sold in the lump or gravel form. The lowest grade of fluorspar, which includes all of the mineral containing over 4 per cent silica and that which is mixed with calcite, is used in foundry work. For this purpose the fluorspar gives a much cleaner iron, and

[a] Bain, H. Foster, Zinc and lead deposits of northwestern Illinois: Bull. U. S. Geol. Survey No. 246, 1905.

its demand should be almost unlimited as foundrymen become better acquainted with its value for use in their furnaces.

The prices of Kentucky and Illinois fluorspar are dependent upon Pittsburg quotations, which are controlled partly by the importers of foreign fluorspar, as these control almost entirely the eastern trade and part of the Pittsburg trade.

PRODUCTION.

During 1904 the production of fluorspar was confined almost entirely to Illinois and Kentucky, with a very small quantity from Arizona. The total production of fluorspar in 1904 amounted to 36,452 short tons, valued at $234,755, as compared with 42,523 short tons, valued at $213,617 in 1903, a decrease of 6,071 short tons in quantity, but an increase of $21,138 in value. This greater value of the 1904 production is due to the comparatively greater quantity of ground fluorspar sold in 1904. Of the 1904 production, 16,360 tons, valued at $81,331, were sold in the form of lump fluorspar as compared with 30,338 tons, valued at $129,971, in 1903, a decrease of 13,978 short tons in quantity and of $48,640 in value; 15,421 short tons of ground fluorspar, valued at $130,210, were sold in 1904, an increase of 10,186 tons in quantity and of $77,864 in value, as compared with 5,235 tons, valued at $52,346, sold in 1903. The remainder of the 1904 production, namely, 4,671 tons, valued at $23,214, was prepared for market but not sold, being still held by the producers, and this would make the total quantity of lump fluorspar produced in 1904, 21,031 tons, valued at $104,545. The average price per ton reported as received for the lump fluorspar was $4.97, which is 69 cents per ton more than the average price of $4.28 received in 1903; it is, however, 22 cents less than the average price of $5.19 per ton received in 1902. The highest price received for lump fluorspar in 1904 was $11.50 per ton, which was for the Arizona production; the lowest price recorded was $3.60 per ton, which was received for a small portion of the Kentucky product. The two extremes in price in 1903 for lump fluorspar were $11.50 and $3 per ton. The lump fluorspar imported into the United States affects the market considerably, especially when there is any decrease in the demand for this mineral.

The average price received for the ground fluorspar in 1904 was $8.44 per ton, a decrease of $1.55 as compared with the average price of $9.99 received in 1903, and a decrease of $1.54 as compared with the average price of $9.98 per ton received in 1902. The prices reported as having been received for the ground fluorspar varied from $8 to $10 per ton.

There were 15 producers of fluorspar in 1904, as compared with 12 in 1903 and with 18 in 1902. These were divided as follows: One in

Arizona, 5 in Illinois, 8 in Kentucky, and 1 in Tennessee. Kentucky was again the State to have the largest output, which was 19,096 short tons, valued at $111,499. This is a decrease of 11,739 short tons in quantity and of $42,461 in value, as compared with the production of 30,835 tons, valued at $153,960, in 1903. The production of Illinois fluorspar in 1904 was 17,205 tons, valued at $122,172. Though this is a smaller output in quantity than that from Kentucky, it is an increase in value, due to a greater quantity of ground fluorspar having been produced in Illinois than in Kentucky. This is a large increase over the production of Illinois fluorspar in 1903, which was 11,413 tons, valued at $57,620, the increase being 5,792 tons in quantity and $64,552 in value. There was a decrease in the combined production of Arizona and Tennessee as compared with 1903 and 1902. In the following table are given the quantity and the value of the fluorspar produced in the United States in 1902, 1903, and 1904, by States:

Production of fluorspar in the United States in 1902, 1903, and 1904, by States.

State.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Arizona and Tennessee	628	$6,872	275	$2,037	151	$1,084
Kentucky	29,030	143,410	30,835	153,960	19,096	111,499
Illinois	18,360	121,532	11,413	57,620	17,205	122,172
Total	48,018	271,814	42,523	213,617	36,452	234,755

The annual production of fluorspar in the United States since 1882 is given in the following table:

Production of fluorspar in the United States, 1882–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1882	4,000	$20,000	1894	7,500	$47,500
1883	4,000	20,000	1895	4,000	24,000
1884	4,000	20,000	1896	6,500	52,000
1885	5,000	22,500	1897	5,062	37,159
1886	5,000	22,000	1898	7,675	63,050
1887	5,000	20,000	1899	15,900	96,650
1888	6,000	30,000	1900	18,450	94,500
1889	9,500	45,835	1901	19,586	113,803
1890	8,250	55,328	1902	48,018	271,832
1891	10,044	78,330	1903	42,523	213,617
1892	12,250	89,000	1904	36,452	234,755
1893	12,400	84,000			

As is seen from this table, there was a very large increase in the production of fluorspar in 1902 as compared with previous years, this being due to the large demand for this mineral in foundries and in the manufacture of steel. Although there was a considerable falling off in the production of 1904, it was still nearly twice that of 1901 and 1900.

IMPORTS.

As there are no separate statements regarding the quantity 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 was felt to some considerable extent, and, so far as can be judged, the importation in 1904 was about the same as in 1903, when it was greater than in 1902.

There is a certain quantity 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.

The source of supply of cryolite is still from Greenland, the deposits being controlled by the Danish Government, which also limits the exportation. Although this mineral has been found sparingly at a number of localities in the United States, none of these have shown any indication of containing cryolite in commercial quantity, and there has never been any production of it in the United States beyond a few specimens, all that is used in this country being imported. The principal use of the imported cryolite is in the manufacture of aluminum and sodium salts, and it is in these processes that the calcium fluoride is obtained as a by-product.

There was a large falling off in the quantity of cryolite imported into the United States in 1904. This amounted to 959 long tons, valued at $13,708, as against 7,708 long tons, valued at $102,879, in 1903. This is the smallest quantity of cryolite imported into the United States since 1871. Since 1885 the importation has, with the exception of 1896, been over 5,000 long tons per year, and in 1887, 1894, and 1897 the importation was over 10,000 long tons per year. In the following table is given the quantity and value of cryolite imported into the United States since 1871.

Imports of cryolite, 1871–1904.

Year ending—	Quantity.	Value.	Year ending—	Quantity.	Value.
June 30—	*Long tons.*		December 31—	*Long tons.*	
1871	....	$71,058	1888	7,388	$98,830
1872	....	75,195	1889	8,603	115,158
1873	....	84,226	1890	7,129	95,405
1874	....	28,118	1891	8,298	76,350
1875	....	70,472	1892	7,241	96,932
1876	....	103,530	1893	9,574	126,688
1877	....	126,692	1894	10,684	142,494
1878	....	105,884	1895	9,425	125,368
1879	....	66,042	1896	3,009	40,056
1880	....	91,366	1897	10,115	135,114
1881	....	103,529	1898	6,201	88,501
1882	3,758	51,589	1899	5,879	78,676
1883	6,508	97,400	1900	5,437	72,763
1884	7,390	106,029	1901	5,383	70,886
December 31—			1902	6,188	85,650
1885	8,275	110,750	1903	7,708	102,879
1886	8,230	110,152	1904	959	13,708
1887	10,328	138,068			

GYPSUM AND GYPSUM PRODUCTS.

By George Perry Grimsley.

PRODUCTION BY CLASSES OF PRODUCT.

Gypsum reaches the market in the form of crude rock, land plaster, plaster of Paris, and wall plaster. The quantity, value, and average price per ton of each of these classes and the totals for 1904 and 1903 are shown in the following table. The total production is estimated as crude, but the total value is that of the product in its different forms as it first reaches the market.

Production of gypsum in United States, 1904 and 1903.

[Short tons.]

Grade.	1904.			1903.		
	Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
Crude	56,137	$61,234	$1.09	73,912	$87,608	$1.19
Land plaster	70,167	142,490	2.03	74,601	154,945	2.08
Plaster of Paris	274,672	882,262	3.21	264,196	1,078,287	4.08
Wall plaster	390,668	1,698,339	4.35	478,347	2,472,103	5.17
Total (estimated as crude)	940,917	2,784,325	....	1,041,704	3,792,943	....

The production of land plaster has been decreasing since 1880, while that of calcined plaster has been increasing. In 1880 about 50 per cent of the total production was ground into land plaster, while in 1904 less than 8 per cent was used in this way. The greatest production of gypsum recorded in the United States was in 1903. As the advantages of hard wall plasters have been recognized by the building trade the demand has increased. There were 77,203 less short tons of calcined plaster used in 1904 than in 1903, though the increase in 1903 over 1902 was 203,156 short tons, due to a large extent to the construction of the staff buildings for the Louisiana Purchase Exposition at St. Louis. The value of land plaster as a fertilizer is a disputed question, and it is not as highly regarded by farmers at the present time as it was twenty years ago. It is only used in a few localities and in these places only in limited amount. It has been replaced by various patent fertilizers to a large extent. The production for 1904 showed a decrease from that of 1903, but was greater than that of any other year. The gypsum sold crude is ground into fertilizer, sold to Portland-cement mills, shipped to some plate-glass factories where it is calcined, and sold to local mills for calcining. A considerable portion of the plaster of Paris is used by plate-glass factories for holding the plates of glass on the polishing tables, and is shipped to local mills in various parts of the country, where it is mixed with dried sand and retarder and sold as patent plaster ready to be mixed with water and applied to the walls.

The following table has been compiled to show the progress of the gypsum industry during the last fifteen years. The annual production and value of the three varieties of gypsum products—crude, ground, and calcined—are given, together with the value per ton of each. A study of these tables shows a decrease in value per ton of the different kinds of gypsum products in 1904 from 1903 and also a decrease in production. The total production is greater than any year except 1903. In calcined plasters there has been a steady growth, with a marked increase in 1903 during the construction of the St. Louis Fair buildings; but the industry of 1904 represents a steady growth under ordinary trade conditions, and its decrease from 1903 is not to be looked upon as a decline in the plaster trade. The proportion of crude gypsum calcined to the total production of crude gypsum increased from 83 per cent in 1902 to nearly 86 per cent in 1903 and to over 86 per cent in 1904. The price of calcined gypsum increased from $3.50 per ton in 1902 to $4.77 in 1903, but decreased to $3.88 in 1904. 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, 1890–1904, classified as to variety.

[Short tons.]

Year.	Total quantity produced.	Sold crude.			Ground into land plaster.		
		Quantity.	Value.	Average price per ton.	Quantity.	Value.	Average price per ton.
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
1904	940,917	56,137	61,234	1.09	70,167	142,490	2.03

Production of gypsum in the United States, 1890–1904, 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.	
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
1904	814,613	665,340	2,580,601	3.88	2,784,325

PRODUCTION BY STATES.[a]

Gypsum is quarried and calcined in the following 17 States and Territories, named in the order of their importance as producers: Michigan, New York, Iowa, Texas, Oklahoma, Ohio, Kansas, Wyoming, Colorado, Utah, Virginia, California, South Dakota, Nevada, Montana, Oregon, and New Mexico. In a number of other States mixing plants are established where plaster of Paris is mixed with retarder and sand to form a hard wall plaster.

One of the objections to the use of hard wall plaster in residences has been its high sound conductivity, so that sounds in one room are heard in adjoining apartments. The introduction of fine-wood fiber into the plaster, forming wood-fiber plaster, has overcome this difficulty to a considerable extent. The manufacture of fiber plaster has made a marked growth in 1904, and many new plants have been established, especially in the Eastern and Southern States. There are but few States at the present time without plaster-mixing plants. The increase in number of these plants has caused a substitution of hard wall plaster for the ordinary lime plaster, which has seriously interfered with the sale of lime for wall plaster. The lime manufacturers are now experimenting on improvements in lime to compete with hard plaster.

A number of new calcining gypsum plants have been established in the West in Iowa, Oklahoma, Colorado, California, and Oregon. There has been a renewed activity in Michigan, and several new companies have been organized to manufacture plaster in the Grand Rapids area. The United States Gypsum Company continues to be

[a] For further discussion of gypsum localities, see Gypsum deposits in the United States: Bull. U. S. Geol. Survey No. 223, 1904.

the largest holder of gypsum mills and properties and controls the following plants:

List of gypsum mills and properties controlled by the United States Gypsum Company.

Name of company.	Kind of plant.	Location.
Oakfield Plaster Manufacturing Co	Calcining mill	Oakfield, N. Y.
English Plaster Works	do	Do.
Genesee Stucco Co	do	Do.
O. B. English Co	do	Do.
Big Four Plaster Co	Mixing plant	Do.
Forrester Plaster Co	do	Buffalo, N. Y.
Granite Wall Plaster Co	do	Pittsburg, Pa.
Ford Plaster Co	do	Allegheny, Pa.
Ohio Adamant Co	do	Cleveland, Ohio.
Granite Wall Plaster Co	Calcining plant	Port Clinton, Ohio.
Marsh & Co	do	Gypsum, Ohio.
Alabaster Co	do	Alabaster, Mich.
Midland Plaster and Cement Co	do	Grand Rapids, Mich.
Durr Plaster Co	do	Grandville, Mich.
Adamant Company of America	Mixing plant	Do.
Adamant Plaster Co	do	Milwaukee, Wis.
Do	do	West Superior, Wis.
Do	do	Minneapolis, Minn.
Zenith Plaster Co	do	St. Paul, Minn.
Baker Plaster Co	Wall finish plant	Do.
Duncombe Stucco Co	Calcining plant	Fort Dodge, Iowa.
Carbon Plaster Co	do	Do.
Iowa Plaster Association	Calcining plants (3)	Do.
Fort Dodge Plaster Co	Calcining plant	Do.
Mineral City Plaster Co	do	Do.
Fitzgerald Plaster Co	Mixing plant	Peoria, Ill.
Zenith Plaster Co	do	Springfield, Ill.
Adamant Plaster Co	do	Evansville, Ind.
Diamond Wall Plaster Co	do	Indianapolis, Ind.
Wymore Plaster Co	Chemical plant	Wymore, Nebr.
Kansas Cement Plaster Co	Calcining plant	Hope, Kans.
Blue Valley Plaster Co	do	Blue Rapids, Kans.
Blue Rapids Plaster Co	do	Do.
Old Roman Plaster Co	do	Springdale, Kans.
Oklahoma Cement Plaster Co	do	Okarche, Okla.

New York.—The gypsum in New York occurs in the Salina group of the Upper Silurian in a series of shales and shaly limestones. The material is worked from Madison County west to Oakfield, in Genesee County. The largest quarries are near Cayuga, which have been worked since 1828. The rock gypsum is mined by stripping off the cover at Fayetteville and Cayuga, by tunnels near Caledonia and Garbuttsville, and by shafts at Oakfield. The rock runs 70 to 90 per cent of lime sulphate or gypsum, with 28 to 10 per cent of lime carbonate, and it has been used mainly for land plaster until recent years. In 1903 over one-fourth of the total output was ground for fertilizer; in 1904 the quantity of gypsum ground into land plaster was a little less than in 1903, but the quantity calcined was increased 23,610 short tons. The value of gypsum products in New York decreased from $462,383 in 1903 to $432,358 in 1904.

Virginia.—The gypsum deposits of Virginia are found in the southwestern part of the State in the valley of the North Fork of the Holston River, in Smyth and Washington counties, in a narrow belt 16 miles long, trending northeast-southwest, and in rocks of Lower Carboniferous age. The rock gypsum is 30 feet thick, covered by 12 feet of blue clay and soil, and dips northwest at an angle of 50°. The mines have been opened along the dipping ledge to a depth of 280 feet. The largest mines are near Saltville and Plasterco, where the rock is partly ground for land plaster and partly calcined into plaster of Paris and wall plaster.

Ohio.—Gypsum is worked at only one locality in Ohio, near Gypsum station, in Ottawa County, 10 miles west of Sandusky. The first mill was erected in Sandusky in 1846. The gypsum is covered by 24 feet of soil and shale, which rests on a 3-foot layer of gypsum separated from the 8-foot layer by a foot of limestone. The floor of the quarries is a lime shale 1 foot thick, resting on a layer of impure gypsum 3 to 5 feet thick. The gypsum beds, according to Orton, are not even and horizontal, but are found in waves and rolls, whose summits rise 5 to 8 feet above the general level.

Michigan.—The gypsum in Michigan is of the massive-rock variety, and occurs in heavy ledges of a high degree of purity. The deposits of economic importance are found in two portions of the State, near Grand Rapids to the west and at Alabaster, on Saginaw Bay, to the east, with a possible third area as yet undeveloped near St. Ignace, in the Upper Peninsula. Near Grand Rapids the gypsum rock occurs in a ledge nearly 12 feet thick, covered by 12 to 15 feet of shale. Above the massive ledge in many parts of the area there is a 6-foot ledge separated from the lower one by a foot of shale. The upper ledge is very irregular in its distribution and runs out even in the same quarry. South of the Grand River the gypsum is worked in open quarry, and north of the river by tunnels and shafts. Below Grand Rapids, at Grandville, the gypsum is covered by 20 feet of gravel. The floor of the quarries is a hard limestone 4 feet in thickness. Prospecting by the diamond drill has revealed valuable deposits of gypsum around Grand Rapids, and a number of new companies have been organized for their development. Three new mills are to be erected. At Alabaster the gypsum face is 16 to 22 feet high, covered by 5 to 16 feet of tough bowlder clay, removed by steam shovel. The rock is calcined at the mill near the quarry, and is also shipped by boats to Chicago and other points. The Alabaster mill located at Chicago was destroyed by fire in 1904. Most of the Michigan gypsum is calcined into plaster, but some is sold as land plaster. The gypsum deposits are found in the Grand Rapids formation of the Lower Carboniferous. The St. Ignace gypsum is in the Salina or Monroe group of the Silurian.

Iowa.—The gypsum deposits of commercial value in Iowa are found in Webster County, in the vicinity of Fort Dodge, over an area of 60 to 75 square miles. The rock has been worked since 1872, and is mined by open quarry, tunnels, and shafts. The thickness of the rock varies from 10 to 30 feet. It rests on the St. Louis limestone, and is thought to be Permian in age. The new mill of the Plymouth Gypsum Company at Fort Dodge has been completed, with three 10-foot kettles, having a capacity of 300 tons daily. The shaft is 80 feet deep, reaching a ledge of gypsum 20 to 28 feet thick. Practically all the Iowa gypsum is calcined into plaster.

Kansas.—The Kansas gypsum deposits of economic importance form a belt trending northeast-southwest across the State. There are three developed areas—the northern or Blue Rapids area, the central or Gypsum City, and the southern or Medicine Lodge. All of these deposits are found in the Permian, the central and northern are near the base of the Upper Permian, and the southern at the top of the Upper Permian in the Red Beds. The gypsum occurs in two forms—rock and gypsum earth. The rock is quarried especially in the northern and southern areas. In the northern area it is about 9 feet in thickness, and in the southern from 3 to 40 feet. The gypsum earth deposits are found especially in the central area, and were the first deposits of this material to be worked in this country. They were of limited extent, and in a number of places they have been exhausted and the mills have been moved to other sections. The industry in Kansas has thus decreased on account of the demand for earth plasters over rock plasters in that section of the country. The large rock deposits of the Medicine Lodge Valley are worked on a very small scale, through lack of railroad transportation. A new railroad has been chartered to pass through this valley, and when built it will open a very large gypsum field and cause renewed activity in the gypsum industry of this State.

Oklahoma.—The extensive gypsum deposits of Oklahoma are of Permian age, and are grouped under four general regions—the Kay County region in the central part of Kay County; the main line of the Gypsum Hills, extending from Canadian County northwest through Kingfisher, Blaine, Woods, and Woodward counties to the Kansas line; the second Gypsum Hills, extending along a line parallel with the main range, and from 50 to 75 miles farther southwest, and the Greer County region, occupying the greater part of western Greer County and the southeastern corner of Roger Mills County. The deposits in Kay County consist of gypsum earth or gypsite, while in the other three regions rock gypsum predominates. The United States Gypsum Company has opened a gypsite deposit at Eldorado. In addition to the four mills that have been in operation, two new mills have been erected. One new mill in Roman Nose Canyon near Watonga, known as the Cantonement Plaster Company,[a] has a daily capacity of 250 tons of plaster made from gypsum earth; the deposit is quite extensive and of good depth and quality. The Acme Cement Plaster Company has erected a new mill at Cement, in the Keechi Hills in Caddo County, using gypsum earth. The Independence Gypsum Company built a 300-ton mill at Southard. The output of gypsum in Oklahoma decreased from 69,158 short tons in 1903 to 53,523 short tons in 1904.

Texas.—Large deposits of gypsum are found in Texas, especially in the western part of the State, but they are only utilized at the present time in the northern part, near Quanah, on the line of the Fort Worth and Denver Railroad. Both rock gypsum and gypsum earth are found in this section, but the latter is used. The first company to locate in this district was the Acme Cement Plaster Company, which has eight kettles, producing about 300 tons of plaster daily. The American Cement Plaster Company also has a mill in this section, using the gypsum earth.

Montana.—Gypsum beds varying from a few inches to 6 feet or more in thickness are found throughout the eastern flanks of the Rocky Mountains in Montana, but have only been developed on a small scale near the railroads in Carbon and Cascade counties, and are probably of Lower Carboniferous age. They have been worked near the towns of Kibbey, Armington, and Bridger.

South Dakota.—In the Black Hills region of South Dakota gypsum is found with a thickness of 30 feet in places, and near Hot Springs its thickness is over 33 feet. Plaster has been made at Hot Springs and at Sturgis for local use, but remoteness from markets has hindered any great development.

Wyoming.—There are a number of gypsum deposits in Wyoming, varying in composition from pure crystal to earth gypsum. At Red Buttes plaster of Paris and wall plaster have been made since 1889. A second locality of plaster manufacture is near Laramie, where a deposit of 180 acres of secondary gypsum earth has been worked since 1896. The gypsum occurs in the Red Beds. The Laramie gypsum earth has an average depth of 9 feet, 7 feet of this is pure gypsite resting on a 5-inch red layer, and below this is a foot or more of white gypsum earth resting on gravel and red clay.

Colorado.—The important gypsum-producing center in Colorado is in Laramie County. The gypsum stratum is found in a valley of erosion one-half mile wide, in the midst of mountain folds of Jura-Trias age. The main quarry at Loveland shows a gypsum face 250 feet long, 28 feet high at the center, and sloping to 7 feet at the edges. The gypsum is compact and gray in color, and is found in two beds,

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[a] Mill destroyed by fire June 16, 1905.

one over the other, having a dip of 15° to the north. The rock is used in this section in the manufacture of plaster of Paris, dental plaster, and cement wall plaster. The mill near Loveland has been increased in size to supply the demand. The Portland Cement Company, at Portland, has erected a 150-ton plaster mill using gypsum and gypsite.

New Mexico.—Large deposits of gypsum are found at various places in New Mexico, associated with the Red Beds. In Otero County, in the southern part of the Territory, there is an accumulation of granular gypsum forming dunes over an area of 350 square miles and known as the "white sands." On account of the small market near at hand and the high freight cost to more distant markets the gypsum deposits have not been developed to any extent. A mill has been erected at Ancho, in Lincoln County, on the Rock Island Railroad, using gypsum earth or gypsite, which is found in a deposit 10 to 20 feet thick.

Arizona.—Gypsum can be obtained in a number of localities in Arizona, especially in the following: The Santa Rita Mountains, Pima County, southeast of Tucson; the low hills along the San Pedro River in Cochise and Pinal counties; the Sierrita Mountains south of Tucson; the foothills of Santa Catalina Mountains, north of Tucson, and the Fort Apache Reservation, in Navajo County. Some gypsum has been quarried and shipped to southern California, and some prospecting has been carried on with a view of establishing a mill in the Territory, but the development at the present time is very small.

Utah.—Large deposits of gypsum are known to exist in the southern and central parts of Utah. The rock gypsum has been worked since 1887 at Nephi, in Juab County. The rock outcrops in the form of a lens 275 to 300 feet thick and 700 feet long. The gypsum is calcined into plaster and shipped over a large area.

Nevada.—In northwestern Nevada there are two localities where gypsum is found in large quantities. One is in the Virginia Range, on the Virginia and Truckee Railroad, where the rock is quarried and shipped to Empire, on the Carson River, and calcined. The other deposit is in the Humboldt Range, 80 to 90 miles east of the California-Nevada boundary, near Lovelocks, on the Central Pacific Railroad. The gypsum rock forms the axis of an anticline and is exposed for three-quarters of a mile. The gypsum was quarried some years ago and then abandoned on account of cost of transportation. Recently a company has been organized to reopen the quarries and ship the rock to California.

California.—The grinding of gypsum rock into land plaster for fertilizer has been carried on at a number of places in California, where deposits of varying thickness and quality have been opened. The manufacture of plaster of Paris in the past has been attended by failure in many cases on account of the selection of poor quality of rock. For many years plaster of Paris was made in San Francisco by the Golden Gate Plaster Company, using in late years a rock from San Marcos Island, in the Gulf of California. This mill was burned a few years ago. At the present time plaster is made near Los Angeles, and one or two new mills are planned for this section.

A new mill is in process of construction at Amboy, located near a "dry lake" of 10,000 acres, having a large deposit of gypsite, which becomes quite salty toward the center of the lake. On the edge the material down to 8 feet below the surface contains about one-half per cent of salt. Good ledges of gypsum are reported at Saltaw and Mecca, in the mountains. Near Bakersfield gypsite deposits of very fine texture are reported by Mr. W. J. Ehrsam.

Oregon.—Beds of rock gypsum of limited extent are found in Oregon on the eastern border of the State, on a ridge dividing Burnt River and Snake River. The rock is used at the 100-ton mill on Burnt River, 4 miles below Huntington, at the station of Lime. The rock is 20 feet thick, is white and crystalline, and is worked by tunnels.

In the following tables, which show the production of gypsum by States for 1903 and 1904, 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 1904, by States.

[Short tons.]

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.	
California, Ohio, and Virginia....	101,809	2,129	$1,768	10,935	$30,257	88,745	71,999	$286,698	$318,723
Colorado and Wyoming	35,778	....	....	....	....	35,778	28,975	135,045	135,045
Iowa	145,359	2,013	4,223	933	1,816	142,413	113,931	469,393	475,432
Kansas and Texas.	173,721	7,136	10,351	2,573	3,866	164,012	132,851	538,143	552,360
Michigan..........	238,385	34,669	32,635	18,294	25,224	185,422	158,266	483,338	541,197
New York	158,892	8,790	10,157	35,760	75,122	114,342	91,794	347,079	432,358
Oklahoma.........	53,523	....	....	2	5	53,521	43,209	190,240	190,245
Other States.......	33,450	1,400	2,100	1,670	6,200	30,380	24,315	130,665	138,965
Total	940,917	56,137	61,234	70,167	142,490	814,613	665,340	2,580,601	2,784,325

Production of gypsum in the United States in 1903, by States.

[Short tons.]

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.	
California, Ohio, and Virginia	103,392	1,337	$2,531	13,065	$34,760	88,990	74,158	$429,822	$467,113
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	137,886	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

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, over one-half entering the port of New York. The gypsum imported is nearly all calcined and converted into wall plaster. A small quantity is used as land plaster, and some is mixed in patent fertilizers. The following tables, reported by the Bureau of Statistics of the Department of Commerce and Labor, show the imports for the fiscal years, given by countries and by the customs districts, in which they were entered:

Imports of crude, ground, or calcined (dutiable) gypsum in the fiscal years ending June 30, 1901, 1902, 1903, and 1904, by countries.

[Long tons.]

Country from which imported.	1904.		1903.		1902.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
France	337	$1,160	57	$395	132	$1,902	185	$1,311
United Kingdom	459	4,869	333	5,422	190	1,854	93	987
Nova Scotia and New Brunswick, etc	260,182	315,558	288,366	319,497	259,353	275,877	196,932	216,636
Mexico	....	....	....	....	....	....	2,236	9,700
Other countries	44	1,004	22	371	20	23	1	36
Total	261,022	322,591	288,778	325,685	259,695	279,656	199,447	228,670

Imports of crude, ground, or calcined (dutiable) gypsum, in the fiscal years ending June 30, 1901, 1902, 1903, and 1904, by customs districts.

[Long tons.]

Customs district into which imported.	1904.		1903.		1902.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Aroostook, Me	80	$157	128	$518	57	$148	415	$796
Bangor, Me	260	156			235	141	390	234
Bath, Me	623	395	883	532	703	429	740	446
Passamaquoddy, Me	8,523	7,447	11,394	11,131	8,395	7,628	8,232	7,942
Portland and Falmouth, Me							180	135
Boston and Charlestown, Mass	7,943	19,073	9,120	19,420	5,760	11,546	5,921	11,118
Gloucester, Mass	330	198			235	144	230	141
Fairfield, Conn	513	1,433	310	930	360	990	315	866
New Haven, Conn	2,277	1,680	4,806	3,490	3,515	3,124	1,916	1,325
New York, N. Y	150,788	184,160	169,232	184,935	157,699	167,444	117,989	138,565
Newark, N. J	22,612	27,970	33,345	38,869	30,388	35,091	19,700	21,751
Perth Amboy, N. J	1,340	1,257	4,910	3,795	6,218	3,733	2,780	1,661
Philadelphia, Pa	49,305	63,897	42,849	52,362	33,343	39,471	23,900	25,233
Delaware					1,630	960	1,387	816
Baltimore, Md	4,894	4,161	2,925	2,487	3,987	3,040	5,635	3,381
Norfolk and Portsmouth, Va	9,670	8,141	5,300	4,513	5,600	4,815	7,480	4,488
Alexandria, Va	1,830	1,521	3,565	2,605	1,550	930		
San Francisco, Cal	2	9					2,236	9,700
Other districts	32	936	11	98	20	22	1	72
Total	261,022	322,591	288,778	325,685	259,695	279,656	199,447	228,670

Gypsum imported and entered for consumption in the United States, 1867–1904.

[Long tons.]

Year ending—	Ground or calcined.		Unground.		Value of manufactured plaster of Paris.	Total value.
	Quantity.[a]	Value.	Quantity.	Value.		
June 30—						
1867		$29,895	97,951	$95,386		$125,281
1868		33,988	87,694	80,362		114,350
1869		52,238	137,039	133,430	$844	186,512
1870		46,872	107,237	100,416	1,432	148,720
1871		64,465	100,400	88,256	1,292	154,013
1872		66,418	95,339	99,902	2,553	168,873
1873		35,628	118,926	122,495	7,336	165,459
1874		36,410	123,717	130,172	4,319	170,901
1875		52,155	93,772	115,664	3,277	171,096
1876		47,588	139,713	127,084	4,398	179,070
1877		49,445	97,656	105,629	7,843	162,917
1878		33,496	89,239	100,102	6,989	140,587
1879		18,339	96,963	99,027	8,176	125,542
1880		17,074	120,327	120,642	12,693	150,409
1881		24,915	128,607	128,107	18,702	171,724
1882	5,737	53,478	128,382	127,067	20,377	200,922
1883	4,291	44,118	157,851	152,982	21,869	218,969

[a] Quantity not reported previous to 1882.

Gypsum imported and entered for consumption in the United States, 1867–1904—Cont'd.

Year ending—	Ground or calcined.		Unground.		Value of manufactured plaster of Paris.	Total value.
	Quantity.	Value.	Quantity.	Value.		
June 30—Continued.						
1884	4,996	$42,904	166,310	$168,000	(a)	$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
December 31—						
1888	3,340	20,764	156,697	170,023	....	190,787
1889	5,[illegible]66	40,291	170,965	179,849	....	220,140
1890	7,568	55,250	171,289	174,609	....	229,859
1891	9,560	97,316	110,257	129,003	....	226,319
1892	6,832	75,608	181,104	232,403	....	308,011
1893	3,363	31,670	164,300	180,254	....	211,924
1894	2,027	16,823	162,500	179,237	....	196,060
1895	3,295	21,526	192,549	215,705	$10,352	247,583
1896	3,292	21,982	180,269	193,544	11,722	227,248
1897	2,664	17,028	163,201	178,686	16,715	212,429
1898	2,973	18,501	166,066	181,364	40,979	240,844
1899	3,265	19,250	196,579	220,603	58,073	297,926
1900	3,109	19,179	209,881	229,878	66,473	315,530
1901	3,106	19,627	235,204	238,440	68,603	326,670
1902	3,647	23,225	305,367	284,942	52,533	360,700
1903	3,526	22,784	265,958	301,379	54,434	378,597
1904	3,278	11,276	294,238	321,306	23,819	356,401

a 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.

[Short tons.]

Year.	France.		United States.		Canada.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1893	....	....	253,615	$696,615	192,568	$196,150
1894	1,693,831	$2,891,365	239,312	761,719	223,631	202,031
1895	2,175,448	3,392,768	265,503	797,447	226,178	202,608
1896	1,866,498	2,661,200	224,254	573,344	207,032	178,061
1897	1,845,874	2,673,033	288,982	755,864	239,691	244,531
1898	1,931,712	2,777,816	291,638	755,280	219,256	230,440
1899	1,802,812	2,641,020	486,235	1,287,080	244,566	257,329
1900	1,761,835	2,772,221	594,462	1,627,203	252,001	259,009
1901	2,182,229	3,449,747	633,791	1,506,641	293,879	340,148
1902	1,975,513	3,318,070	816,478	2,089,341	332,045	356,317
1903	1,798,508	3,134,891	1,041,704	3,792,943	307,489	384,259

The world's production of gypsum, 1893-1903—Continued.

Year.	Great Britain.		German Empire.		Algeria.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	263,151	325,513	28,821	13,228	40,510	109,648
1898	219,549	345,882	28,315	13,166	41,156	110,660
1899	238,071	372,073	32,760	19,660	44,037	117,895
1900	233,002	348,210	39,103	17,199	41,446	139,190
1901	224,919	344,650	[a] 35,013	[a] 23,139	38,955	132,286
1902	251,629	384,263	34,944	12,732	[b] 6,889	52,253
1903	246,282	337,391	34,054	19,145	331	146

Year.	India.		Cyprus.	
	Quantity.	Value.	Quantity.	Value.
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	(c)	(c)	7,784	17,041
1902	(c)	(c)	7,874	17,481
1903	(c)	(c)	11,591	28,766

[a] Includes Baden. [b] Includes Tunis. [c] Not yet available.

USES OF GYPSUM.

Uncalcined gypsum.—Gypsum in its ground uncalcined state is used as land plaster for fertilizer on various soils. Its value in this connection is much disputed, and commercial patent fertilizers have displaced it to a very considerable extent. Many of these, however, have a base of gypsum to which are added the various other ingredients. The white, finely ground, crude gypsum is sometimes sold under the name of terra alba for adulteration purposes. This substance has been detected in white-lead paint, flour, sugar, candy, baking powder, quinine, and other compounds. In India powdered gypsum is kept in the bazaars as a drug. It is supposed to have cooling properties, and a gruel made from it is given in fevers. Gypsum is sometimes added to the water used in brewing. Gypsum flour mixed with the poorer grades of wheat flour is used for dusting molds in some forms of metal casting. Garnierite or hydrous silicate of nickel is smelted in a low-blast furnace with coke and gypsum. In Michigan a special line of manufacture is that of bug plaster, which consists of land plaster mixed with Paris green or other poison and is used on potatoes and vines to destroy the insects. Chalk crayons are now commonly made from ground gypsum pressed and dried. Blocks of gypsum are hardened and polished, forming an artificial marble. Gypsum is added to Portland cement in small quantities up to 3 per cent to retard the set.

Calcined gypsum.—When gypsum is calcined it is known as plaster of Paris. The finer grades are sold as dental plaster and as plaster of Paris for the manufacture of casts and molds. It is also used as white finish on the walls of buildings. Dental plaster is usually reground and carefully sifted, so as to give a superfine plaster free from grit. Plaster was used at one time for glazing porcelain, and has been recommended as a substitute for charcoal in blowpipe tests. It is extensively used in the manufacture of pottery molds. Each jolly wheel in a modern pottery is provided with from 1,000 to 3,000 molds. In England 30,000 to 40,000 tons of plaster are used annually in the potteries. Gypsum paints, or cold-water paints, are made from finely ground plaster of Paris mixed with various mineral colors. When the gypsum is treated with borax, alum, and other chemicals a very hard plaster is formed, known as Keene's, Martin's, Greenwood, etc., cements. About 40,000 tons of gypsum plaster are used annually in polishing plate glass. The plates of glass are embedded in plaster to hold them firmly on the polishing tables. It requires 2,200 pounds of plaster for 1,000 square feet of plate glass. Gypsum plaster is sometimes mixed with sawdust and molded into blocks, which are then readily nailed to the wall for finish. Plaster relief work in the form of staff is especially adapted for decorative construction and remains in good condition for a considerable length of time in outside work. This industry has been prominent at the various world's fairs. When plaster of Paris is mixed with water it sets in a few minutes; but if some substance in the nature of a retarder be added this set is delayed for several hours, and the product is called cement wall plaster. The wood-fiber plaster is a retarded plaster mixed with fine wood fiber.

CHEMICAL COMPOSITION OF GYPSUM.

The following analyses show the chemical composition of gypsum and of gypsum plaster:

Analyses of rock and earth gypsum, by States.

Locality.	Insoluble material.	Iron and alumina.	Lime carbonate.	Lime sulphate.	Water.	Percentage of gypsum.	Authority.
New York	6.05	....	19.86	....	....	74.09	Connecticut Experiment Station.
Ohio	.68	0.16	1.12	77.45	20.14	97.59	Orton, Ohio Survey.
Florida	.07	.01	.52	77.79	21.39	99.18	David T. Day.
Iowa	.65	....	....	78.44	20.76	99.20	G. E. Patrick.
Kansas:							
Rock	.19	.10	1.43	77.46	20.46	97.92	E. H. S. Bailey.
Do	.65	.17	1.53	79.30	18.84	98.14	Do.
Earth	12.13	.99	3.57	64.63	18.75	83.38	Do.
Do	2.31	.37	11.71	67.91	17.72	85.63	Do.
Oklahoma, earth	7.98	.50	1.14	71.70	18.68	90.38	Okarche Cement Co.
Indian Territory, earth.	10.67	.60	10.21	59.46	16.59	76.05	E. H. S. Bailey.
Texas, earth	.91	.21	9.05	69.92	18.85	88.77	Paul Wilkinson.
Colorado	1.46	....	5.96	69.26	21.50	90.76	United States Geological Survey.
Wyoming, earth	4.50	1.27	15.74	64.22	14.00	78.22	Wilbur C. Knight.
California	2.20	....	9.00	....	....	88.80	California Experiment Station.
Do	6.00	....	22.00	....	....	72.60	Do.
Michigan	1.18	1.87	2.57	76.02	19.00	95.02	G. P. Grimsley.
Do	.55	Trace.	1.86	77.76	20.28	98.04	Do.
Canada	1.88	....	....	....	....	94.84	Connecticut Experiment Station.
Do	2.57	....	....	76.44	20.02	96.46	Do.
St. Marcos Island	.16	.31	.93	78.60	20.31	98.91	G. P. Grimsley.

Analyses of gypsum plasters, by States.

Locality.	Insoluble material.	Iron and alumina.	Lime carbonate.	Lime sulphate.	Water.	Authority.
Wyoming, earth	5.50	0.59	7.86	73.73	6.93	Slosson and Moody.
Kansas:						
Rock	1.20	.20	1.68	89.42	6.82	E. H. S. Bailey.
Earth	4.27	.47	3.07	83.55	6.67	Do.
Oklahoma, earth	13.29	.71	4.77	73.67	5.78	Company chemist.
Texas, earth	2.53	.45	11.22	78.81	5.70	Paul Wilkinson.
Michigan	.80	....	1.26	92.95	5.24	F. B. Dains.
Do	1.50	Trace.	1.43	88.55	8.81	Do.
Do	1.60	....	5.84	85.14	6.63	E. H. S. Bailey.
France	.70	.40	5.30	86.85	6.75	Durand Claye.
Do	3.70	2.70	12.00	72.60	3.55	Do.

A comparative study of these analyses shows that the range of gypsum (lime sulphate and water) varies from 72.6 per cent in California to 99.18 in Florida and 99.20 in Iowa. The gypsum of Ohio, Florida, Iowa, Kansas, and Michigan will average close to 98 per cent. The Canada gypsum will run about 94 per cent. The California rock averages, with the gypsum earth deposits of Wyoming, Kansas, Oklahoma, and Texas, 72 to 88 per cent. The silica impurity in the rock gypsum is usually small—1 per cent and under; but it runs from 4 to 6 per cent in New York and California gypsum and up to 12 per cent in the gypsum earth. Lime carbonate in the rock averages about 1 per cent, reaching 19.86 in New York and 22 per cent in California. The theoretical percentage of water is 20, and it ranges in these analyses from 18 to 22 per cent. The average percentage of lime sulphate plus water, or gypsum, in the analyses of rock quoted is 92.97, or, omitting California and New York, it is 96.91.

After calcining, the plaster should contain theoretically 93.8 per cent lime sulphate and 6.2 per cent of water. The table of analyses gives the composition of several types of good plasters.

PHOSPHATE ROCK.

By Edmund Otis Hovey.

PRODUCTION.

The year 1904 was a prosperous one for the producer of phosphate rock in the United States. More rock was mined than ever before, and better prices were obtained than have been reported since 1893. Many farmers report production and sales during 1904, but the bulk of the business is carried on by a comparatively small number of large concerns. Consolidation seems to be the order of the day.

The reports made to the United States Geological Survey show that the total quantity of phosphate rock marketed from the mines during 1904 amounted to 1,874,428 long tons, valued at $6,873,625, as compared with 1,581,576 long tons, valued at $5,319,294, in 1903, an increase in quantity of 292,852 long tons, and in value of $1,554,331.

The total quantity of phosphate rock reported as having been mined during 1904 was 1,991,169 long tons, as compared with 1,618,799 long tons in 1903; and a stock of 116,741 long tons is reported as having been on hand January 1, 1905. On the other hand, the sale of 66,245 long tons of the quantity of phosphate rock on hand January 1, 1904, is reported. It may be remarked, in passing, that the reports for 1904 are more detailed and complete than heretofore.

The following table gives the production of phosphate rock in the United States from 1892 to 1904, inclusive, based on the marketed product, classified by kinds or grades:

Production of phosphate rock in the United States, 1893–1904, based on the quantity marketed.

State.	1893.		1894.		1895.		1896.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Florida:	*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
Hard rock....	215,685	$1,117,732	326,461	$979,383	307,098	$1,302,096	296,811	$1,067,525
Soft rock.....	13,675	64,626	....	....	6,916	32,000	400	2,300
Land pebble.	86,624	359,127	98,885	296,655	181,011	593,716	97,936	176,972
River pebble.	122,820	437,571	102,307	390,775	73,036	185,090	100,052	300,556
Total.......	438,804	1,979,056	527,653	1,666,813	568,061	2,112,902	495,199	1,547,353
South Carolina:								
Land rock....	308,435	1,408,785	307,305	1,252,768	270,560	898,787	267,072	792,457
River rock ...	194,129	748,229	142,803	492,808	161,415	512,245	135,351	389,192
Total.......	502,564	2,157,014	450,108	1,745,576	431,975	1,411,032	402,423	1,181,649
Tennessee........	....	....	19,188	67,158	38,515	82,160	26,157	57,370
North Carolina...	....	....	....	....	....	....	7,000	17,000
Grand total.	941,368	4,136,070	996,949	3,479,547	1,038,551	3,606,094	930,779	2,803,372

Production of phosphate rock in the United States, 1893–1904, etc.—Continued.

State.	1897.		1898.		1899.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Florida:	*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
Hard rock	360,147	$1,063,713	366,810	$1,396,108	460,297	$2,119,130	424,977	$2,229,373
Soft rock	2,300	4,600						
Land pebble	92,132	180,794	155,084	293,688	177,170	515,458	221,403	612,703
River pebble	97,763	244,408	79,000	158,000	88,953	169,473	59,863	141,236
Total	552,342	1,493,515	600,894	1,847,796	726,420	2,804,061	706,243	2,983,312
South Carolina:								
Land rock	267,380	748,050	298,610	856,225	223,949	738,969	266,186	877,405
River rock	90,900	238,522	101,274	251,047	132,701	339,130	62,987	164,565
Total	358,280	986,572	399,884	1,107,272	356,650	1,078,099	329,173	1,041,970
Tennessee	128,723	193,115	308,107	498,392	430,192	1,192,916	454,491	1,328,707
North Carolina					440	(a)		
Pennsylvania					2,000	9,000	900	4,500
Alabama							334	534
Arkansas							75	225
Other States								
Grand total	1,039,345	2,673,202	1,308,885	3,453,460	1,515,702	5,084,076	1,491,216	5,359,248

State.	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Florida:	*Long tons.*		*Long tons.*		*Long tons.*		*Long tons.*	
Hard rock	457,568	$2,393,080	429,384	$1,743,694	412,876	$1,988,243	531,087	$2,672,184
Land pebble	247,454	660,702	350,991	810,792	390,882	885,425	460,834	1,102,993
River pebble	46,974	105,691	5,055	9,711	56,578	113,156	81,030	199,127
Total	751,996	3,159,473	785,430	2,564,197	860,336	2,986,824	1,072,951	3,974,304
South Carolina:								
Land rock	225,189	716,101	245,243	753,220	233,540	721,303	258,806	830,117
River rock	95,992	245,739	68,122	166,505	25,000	62,500	12,000	31,200
Total	321,181	961,840	313,365	919,725	258,540	783,803	270,806	861,317
Tennessee	409,653	1,192,090	390,799	1,206,647	460,530	1,543,567	530,571	2,037,804
North Carolina					45	500		
Pennsylvania	893	3,000	100	400			100	200
Alabama								
Arkansas			550	1,650	2,125	4,600		
Other States			70	825				
Grand total	1,483,723	5,316,403	1,490,314	4,693,444	1,581,576	5,319,294	1,874,428	6,873,625

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, 1880–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1880	211,377	$1,123,823	1893	941,368	$4,136,070
1881	266,734	1,980,259	1894	996,949	3,479,547
1882	332,077	1,992,462	1895	1,038,551	3,606,094
1883	378,380	2,270,280	1896	930,779	2,803,372
1884	431,779	2,374,784	1897	1,039,345	2,673,202
1885	437,856	2,846,064	1898	1,308,885	3,453,460
1886	430,549	1,872,936	1899	1,515,702	5,084,076
1887	480,558	1,836,818	1900	1,491,216	5,359,248
1888	448,567	2,018,552	1901	1,483,723	5,316,403
1889	550,245	2,937,776	1902	1,490,314	4,693,444
1890	510,499	3,213,795	1903	1,581,576	5,319,294
1891	587,988	3,651,150	1904	1,874,428	6,873,625
1892	681,571	3,296,227			

PRODUCTION BY STATES.

FLORIDA.

The State of Florida continues to be the largest producer of phosphate rock in the United States, her output forming more than one-half the total production of the country. A comparison of the production by varieties in that State during 1904 and 1903 shows that there has been an increase of about 29 per cent in the output of hard rock, an increase of about 18 per cent in that of land pebble, and an increase of more than 43 per cent in that of river pebble. The comparative production of the last two years in Florida may be summarized as follows:

Hard rock, 531,087 long tons, valued at $2,672,184, in 1904, as compared with 412,876 long tons, valued at $1,988,243, in 1903. The average price obtained increased from $4.82 in 1903 to $5.03 in 1904, free on board at the mines.

Land pebble, 460,834 long tons, valued at $1,102,993, in 1904, as compared with 390,882 long tons, valued at $885,425, in 1903, a slight increase in average value per ton, from $2.27 in 1903 to $2.39 in 1904.

River pebble, 81,030 long tons, valued at $199,127, in 1904, as compared with 56,578 long tons, valued at $113,156, in 1903, a noteworthy increase in average value per ton from $2 in 1903 to $2.46 in 1904.

The total marketed production was 1,072,951 long tons, valued at $3,974,304, in 1904, as compared with 860,336 long tons, valued at $2,986,824, in 1903, which shows an average increase in value per ton at the mines from $3.47 in 1903 to $3.70 in 1904. The reports also show that 72,647 long tons of hard rock were mined but not marketed, and that 57,511 long tons of the stock carried over from previous years were marketed in 1904. Hence the total quantity mined in 1904 was 1,088,087 long tons.

The relative proportions of the different kinds were, approximately, hard rock 49.4 per cent, land pebble 43 per cent, river pebble 7.6 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 1898 to 1904, inclusive, based upon the reports of marketed material:

Quantity and value of phosphate rock marketed in Florida, 1898–1904, classified by grades.

Year.	Hard rock.		Land pebble.		River pebble.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*		*Long tons.*	
1898	366,810	$1,396,108	155,084	$293,688	79,000	$158,000	600,894	$1,847,796
1899	460,297	2,119,130	177,170	515,458	88,953	169,473	726,420	2,804,061
1900	424,977	2,229,373	221,403	612,703	59,863	141,236	706,243	2,983,312
1901	457,568	2,393,080	247,454	660,702	46,974	105,691	751,996	3,159,473
1902	429,384	1,743,694	350,991	810,792	5,055	9,711	785,430	2,564,197
1903	412,876	1,988,243	390,882	885,425	56,578	113,156	860,336	2,986,824
1904	531,087	2,672,184	460,834	1,102,993	81,030	199,127	1,072,951	3,974,304

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, 1888–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1888	3,000	$21,000	1898	600,894	$1,847,796
1889	4,100	28,000	1899	726,420	2,804,061
1890	46,501	338,190	1900	706,243	2,983,312
1891	112,482	703,013	1901	751,996	3,159,473
1892	287,343	1,418,418	1902	785,430	2,564,197
1893	438,804	1,979,056	1903	860,336	2,986,824
1894	527,653	1,666,813	1904	1,072,951	3,974,304
1895	568,061	2,112,902	Total	8,539,755	31,628,227
1896	495,199	1,547,353			
1897	552,342	1,493,515			

The record of the Florida hard-rock phosphate production, prepared by Messrs. Auchincloss Brothers, shows that the total shipments of hard-rock during 1904, as reported to them, were 494,044 long tons, as compared with 467,872 long tons during 1903, an increase of 26,172 long tons, or 5.6 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 1904, inclusive:

Number and condition of hard-rock plants in Florida, 1896–1904.

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
1904 [a]	31	5	5	41

[a] As reported to the Survey.

The following tables of shipments of Florida phosphate rock since 1897, 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, 1897–1904.

Month.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
January	12,924	11,682	28,560	23,359	17,673	19,113	15,222	19,942
February	20,668	26,850	32,630	28,623	32,412	24,265	22,305	41,920
March	37,243	34,049	43,051	25,232	44,751	35,998	48,869	43,590
April	32,608	22,274	59,001	52,398	35,945	57,185	74,351	45,926
May	45,715	31,992	48,584	44,598	33,349	35,987	39,913	49,362
June	32,837	31,948	23,051	21,950	23,039	47,452	29,805	42,079
July	22,639	53,114	48,747	38,822	28,791	42,700	34,426	43,486
August	19,292	27,409	41,155	21,491	57,497	16,485	35,646	33,374
September	59,966	46,961	35,728	20,711	51,781	72,516	47,095	55,917
October	27,664	21,476	36,694	26,174	49,093	70,123	47,439	43,717
November	20,184	30,595	28,947	24,222	30,326	42,180	33,622	43,287
December	18,537	22,155	18,527	20,976	19,473	28,606	39,179	31,444
Total	350,277	360,505	444,675	348,556	424,130	492,610	467,872	494,044

The following is the record of shipments to each country for the last eight years:

Shipments of Florida hard-rock phosphate, by countries, 1897–1904.

Country.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
England	24,163	23,849	31,789	20,542	28,790	30,068	28,246	37,620
Scotland	5,957	6,000	9,545	1,790	6,185	12,430	5,311	12,957
Ireland	2,953	3,420	....	5,852	5,175	8,850	9,714	10,218
Germany	181,355	186,731	243,887	208,422	214,280	264,550	246,824	205,703
Belgium	22,954	38,903	37,103	31,639	58,181	41,245	35,400	32,703
Holland [a]	53,039	64,309	87,167	54,349	72,158	77,176	73,280	100,603
Denmark	11,019	8,287	5,475	2,930	12,814	2,750	11,870	8,450
Norway and Sweden	7,442	9,378	11,938	8,000	....	10,250	15,862	28,215
France	13,931	....	3,165	....	6,498	3,950	5,865	20,085
Italy	16,931	11,040	4,546	....	5,842	16,363	18,542	8,040
Russia	3,613	....	1,700	2,702	....	2,600	....	14,866
Austria	4,505	4,946	....	5,922	8,114	14,310	9,000	2,200
Spain	....	....	....	2,500	2,600	5,964	5,606	5,584
United States, West Indies, Australia, Japan, Hawaii, etc.	2,415	3,642	8,360	3,908	3,493	2,104	2,352	6,800
Total	350,277	360,505	444,675	348,556	424,130	492,610	467,872	494,044

[a] A large proportion of the shipments to Rotterdam are forwarded to the interior of Germany.

Total shipments of Florida hard-rock phosphate, 1891–1904.

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	1904	494,044
1895	306,046	1900	348,556		

Shipments of Florida land-pebble phosphate, 1900–1904.

	1900.	1901.	1902.	1903.	1904.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
United Kingdom ports	2,540	10,596	22,035	29,226	27,945
Baltic ports	19,310	24,518	32,785	40,550	76,740
Continental ports	24,826	26,720	40,942	41,655	63,610
Mediterranean ports	31,980	30,200	34,953	34,630	50,450
Other foreign ports	14,070	19,743	5,046	5,700	....
Total foreign shipments	92,726	111,777	135,761	151,761	218,745
Total domestic shipments	124,149	156,649	108,800	157,015	133,549
Total shipments	216,875	268,426	334,561	308,776	352,294

Shipments of Florida river-pebble phosphate, 1900–1904.

	1900.	1901.	1902.	1903.	1904.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
United Kingdom ports	21,427	18,855	4,000	....	....
Continental ports	....	....	....	....	....
Mediterranean ports	....	....	....	....	....
Other foreign ports	....	....	....	....	....
Total foreign shipments	21,427	18,855	4,000	....	....
Total domestic shipments	33,079	31,828	3,070	66,655	79,195
Total shipments	54,506	50,683	7,070	66,655	79,195

SOUTH CAROLINA.

In South Carolina the diminution in production which has been shown by the reports for the last five years has received a slight check, there having been an 11 per cent increase in the production of land rock, which more than made good the continued decline in river rock. The total production of South Carolina phosphate rock in 1904 was 270,806 long tons, valued at $861,317, as compared with 258,540 long tons, valued at $783,803, in 1903, distributed as follows: Land rock, 258,806 long tons, valued at $830,117, in 1904, as compared with 233,540 long tons, valued at $721,303, in 1903; river rock, 12,000 long tons, valued at $31,200, in 1904, as compared with 25,000 long tons, valued at $62,500, in 1903.

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 1904, when there was an increase over 1903 of 12,266 long tons, valued at $77,514. The stock on hand January 1, 1905, was reported as being very small.

The following tables show 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, 1867–1896.

Year ending—	Land companies.	River companies.	Total.	Year ending—	Land companies.	River companies.	Total.
May 31—	*Long tons.*	*Long tons.*	*Long tons.*	May 31—	*Long tons.*	*Long tons.*	*Long tons.*
1867	6	....	6	1884	250,297	181,482	431,779
1868	12,262	....	12,262	1885	225,913	169,490	395,403
1869	31,958	....	31,958	Dec. 31—			
1870	63,252	1,989	65,241	1885[a]	149,400	128,389	277,789
1871	56,533	17,655	74,188	1886	253,484	177,065	430,549
1872	36,258	22,502	58,760	1887	261,658	218,900	480,558
1873	33,426	45,777	79,203	1888	290,689	157,878	448,567
1874	51,624	57,716	109,340	1889	329,543	212,102	541,645
1875	54,821	67,969	122,790	1890	353,757	110,241	463,998
1876	50,566	81,912	132,478	1891	344,978	130,538	475,516
1877	36,431	126,569	163,000	1892	243,652	150,575	394,227
1878	112,622	97,700	210,322	1893	308,435	194,129	502,564
1879	100,779	98,586	199,365	1894	307,305	142,803	450,108
1880	125,601	65,162	190,763	1895	270,560	161,415	431,975
1881	142,193	124,541	266,734	1896	267,072	135,351	402,423
1882	191,305	140,772	332,077	Total	5,175,582	3,378,386	8,553,968
1883	219,202	159,178	378,380				

[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, 1897–1904, 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
1904	258,806	830,117	12,000	31,200	270,806	861,317
Total	2,018,903	6,241,390	588,976	1,499,208	2,607,879	7,740,598

There has been produced in South Carolina a total of 7,194,485 long tons of land rock and 3,967,362 long tons of river rock; a grand total of 11,161,847 long tons, with a total value of $24,035,164.

TENNESSEE.

Tennessee showed in 1904 the largest marketed output since the beginning of the industry, eleven years ago. The output and the value of the material at the mines are shown in the following table:

Production of phosphate rock in Tennessee, 1894–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1894	19,188	$67,158	1901	409,653	$1,192,090
1895	38,515	82,160	1902	390,799	1,206,647
1896	26,157	57,370	1903	460,530	1,543,567
1897	128,723	193,115	1904	530,571	2,037,804
1898	308,107	498,392	Total	3,190,843	9,384,170
1899	424,109	1,177,160			
1900	454,491	1,328,707			

As may be seen from the table, the marketed production of the State for 1904 was 530,571 long tons, valued at $2,037,804, as compared with 460,530 long tons, valued at $1,543,567, in 1903. The increase in average value at the mines was from $3.35 per long ton in 1903 to $3.84 per long ton in 1904. The year 1904 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. About 6,791 long tons are reported as having been sold from the stock carried over from the preceding year, and the stock on hand January 1, 1905, is reported as being 43,334 long tons.

The following statement of shipments of Tennessee phosphate rock by water from Pensacola, Norfolk, and Newport News during the last six 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, Dunkirk received nearly one-third of the shipments, Havre nearly one-quarter, and Antwerp nearly one fifth. Of the Mediterranean ports, Genoa received nearly one-half of all shipments and Venice received nearly one-quarter.

Shipments of Tennessee phosphate from Pensacola, Norfolk, and Newport News, 1899–1904.

	1899.	1900.	1901.	1902.	1903.	1904.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
United Kingdom ports	28,135	3,080	10,217	11,701	10,374	7,571
Baltic ports	2,758	....	....	....	....	....
Continental ports	63,156	55,221	56,639	35,111	31,956	38,072
Mediterranean ports	66,382	69,014	58,309	56,106	66,935	71,471
Other foreign ports	2,100	....	....	....	....	....
Total foreign shipments	162,531	127,315	125,165	102,918	109,265	117,114
Total domestic shipments	10,212	....	....	....	2,650	5,850
Total shipments	172,743	127,315	125,165	102,918	111,915	122,964

PENNSYLVANIA.

Pennsylvania is the only other State reporting phosphate during 1904. It reports but 100 long tons, valued at $200.

PRICES.

During 1904 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, $5.03 per long ton. In 1903 this grade averaged $4.82, and it brought $4.06 in 1902, $5.23 in 1901, $5.25 in 1900, and $4.60 in 1899. Land pebble averaged $2.39 per long ton at the mines in 1904. This grade continuously decreased in average price for the four years preceding 1904, the price obtained having been $2.77 in 1900, $2.67 in 1901, $2.31 in 1902, and $2.27 in 1903; so that a slight recovery is observable for 1904. River pebble averaged $2.46 per long ton in 1904, whereas it brought but $2 per long ton in 1903 and $1.92 in 1902, a noteworthy increase.

In South Carolina the average price per long ton received for land rock in 1904 was $3.21. In 1903 the average price obtained at the mines was $3.09; in 1902, $3.07; in 1901, $3.18; in 1900, $3.30, and in 1899, $3.30. River rock shows a slight gain in the average price, $2.60 per long ton being realized in 1904, as compared with $2.50 in 1903, $2.44 in 1902, $2.56 in 1901, $2.61 in 1900, and $2.56 in 1899.

In Tennessee the average price obtained at the mines for phosphate rock has increased steadily since 1897, with the exception of a slight check in 1901. The average price in 1904 was $3.84 per long ton, free on board at the mines. The average prices obtained in recent previous years have been: 1898, $1.62; 1899, $2.77; 1900, $2.92; 1901, $2.91; 1902, $3.09, and 1903, $3.35.

IMPORTS.

The following table shows the imports of fertilizers of all kinds into the United States from 1868 to 1904, inclusive:

Fertilizers imported and entered for consumption in the United States, 1868–1904.

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	20,934	393,039	40,068	611,284	1,004,323
December 31—					
1886	13,520	306,584	82,608	1,179,724	1,486,308
1887	10,195	252,265	53,100	644,301	896,566
1888	7,381	125,112	36,405	329,013	454,125
1889	15,991	313,956	35,661	403,205	717,161
1890	4,642	59,580	31,191	252,787	312,367
1891	11,937	199,044	29,743	214,671	413,715
1892	3,073	46,014	92,476	666,061	712,075
1893	5,856	97,889	106,549	718,871	816,760
1894	5,757	105,991	126,820	904,247	1,010,238
1895	4,270	51,642	80,088	450,379	502,021
1896	6,532	79,815	113,955	639,858	719,673
1897	4,930	55,715	200,598	970,836	1,026,551
1898	4,482	50,783	[a] 17,966	98,610	149,393
1899	2,700	27,006	17,330	128,579	155,585
1900	5,161	38,184	21,252	181,462	219,646
1901	7,820	89,202	24,439	140,940	230,142
1902	8,393	164,783	57,558	388,479	553,262
1903	21,985	252,132	141,859	756,287	1,008,419
1904	37,127	498,702	134,467	825,487	1,324,189

[a] Until 1898 the crude potassium salts, kieserite and kainite, were included under "Other substances used for fertilizing purposes," in addition to apatite and bone dust or bone ash. The imports of kieserite and kainite since 1898, inclusive, are as follows: 1898, long tons, 121,506 ($621,443); 1899, long tons, 133,472 ($777,602); 1900, long tons, 181,353 ($1,201,272); 1901, long tons, 240,937 ($1,360,619); 1902, long tons, 225,413 ($1,016,032); 1903, long tons, 158,313 ($773,758); 1904, long tons, 218,957 ($1,050,082).

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	3,510	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	1,330,264	3,453,460	1,540,506	5,084,076

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	361,398	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	543,900	2,480,454
Norway	300	4,445	(b)	....	(b)	....
Redonda (Br. West Indies)	2,230	13,720	Nil.	....	132	791
Russia	25,663	(c)	21,276	72,608	13,709	48,741
Spain	4,170	18,590	4,220	16,880	1,150	4,600
Tunis	....	....	....	....	264,930	1,075,616
United Kingdom	630	5,425	71	680	87	530
United States	1,515,179	5,359,248	1,507,548	5,316,403	1,514,244	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 1904 amounted to 22,030,002 barrels (of 280 pounds), valued at $6,021,222, as compared with 18,968,089 barrels, valued at $5,286,988, in 1903.

The quantity produced is the largest ever reported, except in 1902 (see table next page), but the average net price per barrel (27.332 cents) is lower than that reported in 1903 (27.873 cents) or in any previous year, with the exception of 1902, when the average net price realized according to the report was only 23.769 cents per barrel.

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 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 salt production of the United States by grades during the last ten years. The most noteworthy feature of the year 1904 was the increase of 1,193,620 barrels in the production of rock salt. This increase was due in large part to the expansion of the salt industry of Louisiana, where rock salt is easily and cheaply mined in the "mounds" which occur in the southern part of the State:

Production of salt, by grades, in the United States, 1895–1904.

Year.	Table and dairy.	Common fine.	Common coarse.	Packers.	Solar.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
1895	2,173,123	6,099,480	280,284	118,801	983,870
1896	2,230,409	6,598,733	300,365	163,035	2,531,086
1897	2,555,278	6,868,798	516,143	609,378	3,614,491
1898	2,198,339	8,583,128	873,671	379,635	3,077,024
1899	1,866,165	6,883,352	4,562,217	182,930	3,483,858
1900	2,312,130	6,773,217	1,921,321	145,305	1,086,916
1901	2,177,447	7,159,953	1,630,560	84,636	1,200,141
1902	2,027,798	6,692,587	1,571,137	466,987	1,172,484
1903	2,441,908	6,351,855	1,829,460	270,170	1,743,101
1904	2,508,408	6,819,109	2,604,981	96,130	1,189,393

Production of salt, by grades, in the United States, 1895–1904—Continued.

Year.	Rock.	Milling.	Other grades.	Total production.	Total value.
	Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	
1895	2,089,763	40,107	1,884,221	13,669,649	$4,423,084
1896	1,783,886	133,271	109,941	13,850,726	4,040,839
1897	1,649,459	....	159,655	15,973,202	4,920,020
1898	2,183,801	156,579	160,457	17,612,634	6,212,554
1899	2,544,036	96,178	89,878	19,708,614	6,867,467
1900	2,974,033	85,357	5,571,063	20,869,342	6,944,603
1901	3,237,938	72,460	5,003,526	20,566,661	6,617,449
1902	2,889,836	127,521	8,900,881	23,849,231	5,668,636
1903	3,175,521	37,657	3,118,417	18,968,089	5,286,988
1904	4,369,141	349,421	4,093,419	22,030,002	6,021,222

The subjoined table gives the total annual production of salt in the United States since 1893, when the present method of collecting statistics was begun. The value given is the net value of the salt at mine or well, exclusive of barrels or other packing material.

Production and value of salt in the United States, 1893–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Barrels.			*Barrels.*	
1893	11,897,208	$4,154,668	1899	19,708,614	$6,867,467
1894	12,968,417	4,739,285	1900	20,869,342	6,944,603
1895	13,669,649	4,423,084	1901	20,566,661	6,617,449
1896	13,850,726	4,040,839	1902	23,849,231	5,668,636
1897	15,973,202	4,920,020	1903	18,968,089	5,286,988
1898	17,612,634	6,212,554	1904	22,030,002	6,021,222

The chief salt-producing States are New York and Michigan, and the combined output from these two States amounts to about two-thirds of the total production of the United States. As will be seen from the following table, the five leading salt-producing States during 1904 were New York, 8,600,656 barrels (39.04 per cent); Michigan, 5,425,904 barrels (24.63 per cent); Ohio, 2,455,829 barrels (11.15 per cent); Kansas, 2,161,819 barrels (9.81 per cent), and Louisiana, 1,095,850 barrels (4.97 per cent). These five States contributed 89.60 per cent of the total quantity of salt produced in the country during the year.

Production of salt, by States, during 1901, 1902, 1903, and 1904.

State.	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Barrels.		*Barrels.*		*Barrels.*		*Barrels.*	
New York	7,286,320	$2,089,834	8,523,389	$1,938,539	8,170,648	$2,007,807	8,600,656	$2,101,568
Michigan	7,729,641	2,437,677	8,131,781	1,535,823	4,297,542	1,119,984	5,425,904	1,579,206
Ohio	1,153,535	455,924	2,109,987	593,504	2,798,899	795,897	2,455,829	478,523
Kansas	2,087,791	614,365	2,158,486	514,401	1,555,934	564,232	2,161,819	717,101
Louisiana	(a)	(a)	(a)	(a)	568,936	178,342	1,095,850	320,000
California	601,659	133,656	682,660	253,085	629,701	198,630	821,557	205,435
West Virginia	231,722	94,732	208,592	97,721	244,236	35,797	575,000	66,470
Texas	(a)	(a)	347,906	143,683	314,000	117,647	376,695	149,246
Utah	334,484	326,016	417,501	270,626	212,955	181,710	253,829	321,301
Other States	1,141,509	465,245	1,268,929	321,254	175,238	86,942	262,863	82,372
Total	20,566,661	6,617,449	23,849,231	5,668,636	18,968,089	5,286,988	22,030,002	6,021,222

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 94.9 per cent in 1904, while the consumption of salt imported into the United States decreased from 36.5 per cent of the total in 1880 to 5.1 per cent in 1904. The actual consumption in 1904 was 23,116,971 barrels, or about 2.46 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 1904 show an increase to 22,030,002 barrels of domestic salt produced, while the imports decreased to 1,186,712 barrels.

Supply of salt for domestic consumption, 1880–1904.

[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	3,099,699
Total	9,388,699	9,839,994	9,497,541	9,291,930
Exports	4,436	9,091	8,417	10,829
Domestic consumption	9,384,263	9,830,903	9,489,124	9,281,101
Increase over preceding year		446,640	b 341,779	b 208,023
Percentage of imports to total consumption	36.5	39.1	32.5	33.4

a Estimated.

b Decrease.

Supply of salt for domestic consumption, 1880–1904—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	2,587,746
Total	9,761,286	10,266,033	10,525,704	10,591,708
Exports	14,003	14,649	17,246	16,732
Domestic consumption	9,747,283	10,251,384	10,508,458	10,574,976
Increase over preceding year	466,182	504,101	257,074	66,518
Percentage of imports to total consumption	33.3	31.5	26.8	24.5

Source.	1888.	1889.	1890.	1891.
Domestic production	8,055,881	8,005,565	8,876,991	9,987,945
Imports	2,232,253	1,833,452	1,838,024	1,694,048
Total	10,288,134	9,839,017	10,715,015	11,681,993
Exports	19,140	19,209	17,597	15,889
Domestic consumption	10,268,994	9,819,808	10,697,418	11,666,104
Increase over preceding year	[a] 305,982	[a] 449,186	877,610	968,686
Percentage of imports to total consumption	21.7	18.7	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	1,550,556	1,996,970
Total	13,332,309	13,141,919	14,518,973	15,666,619
Exports	18,603	20,686	38,763	36,855
Domestic consumption	13,313,706	13,121,233	14,480,210	15,629,764
Increase over preceding year	1,647,602	[a] 192,473	1,358,977	1,149,554
Percentage of imports to total consumption	12.3	9.5	10.7	12.8

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	90,001
Domestic consumption	15,645,949	17,412,040	18,876,131	20,968,979
Increase over preceding year	16,185	1,766,091	1,464,091	2,092,848
Percentage of imports to total consumption	11.9	8.6	7.0	6.4

Source.	1900.	1901.	1902.	1903.	1904.
Domestic production	20,869,342	20,566,661	23,849,231	18,968,089	22,030,002
Imports	1,427,921	1,440,950	1,319,744	1,171,288	1,186,712
Total	22,297,263	22,007,611	25,168,975	20,139,377	23,216,714
Exports	53,650	67,376	36,388	91,070	99,743
Domestic consumption	22,243,613	21,940,235	25,132,587	20,048,307	23,116,971
Increase over preceding year	1,274,634	[a] 303,378	3,192,352	[a] 5,084,280	3,068,664
Percentage of imports to total consumption	6.4	6.6	5.3	5.8	5.1

[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 Department of Commerce and Labor, 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 403,465,945 pounds in 1901, and decreased to 369,528,186 pounds in 1902 and to 327,960,707 pounds in 1903, and increased again to 332,279,481 pounds in 1904. Since 1867 the imports have been as follows:

Salt imported and entered for consumption in the United States, 1867–1904.

Year ending—	In bags, barrels, and other packages.		In bulk.	
	Quantity.	Value.	Quantity.	Value.
June 30—	*Pounds.*		*Pounds.*	
1867	254,470,862	$696,570	229,304,323	$336,302
1868	308,446,080	915,546	219,975,096	365,458
1869	297,382,750	895,272	256,765,240	351,168
1870	288,479,187	797,194	349,776,433	507,874
1871	283,993,799	800,454	274,730,573	355,318
1872	258,232,807	788,893	257,637,230	312,569
1873	239,494,117	1,254,818	388,012,132	525,585
1874	358,375,496	1,452,161	427,294,209	649,838
1875	318,673,091	1,200,541	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	532,831
1878	352,109,963	1,062,995	414,813,516	483,909
1879	375,286,472	1,150,018	434,760,132	532,706
1880	400,970,531	1,180,082	449,743,872	548,425
1881	412,442,291	1,242,543	529,361,041	658,068
1882	329,969,300	1,086,932	399,100,228	474,200
1883	312,911,360	1,035,946	412,938,686	451,001
1884	340,759,010	1,093,628	441,613,517	433,827
1885	351,276,969	1,030,029	412,322,341	386,858
December 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	627,134	234,499,635	249,232
1890	172,611,041	575,260	243,756,044	252,848
1891	150,033,182	492,144	220,309,985	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	1,627,030	1,640
1897	36,801,048	114,072	50,775,105	46,412
1898	114,573,146	361,366	178,458,117	165,784
1899	119,720,721	372,921	158,263,237	133,862
1900	113,194,092	368,802	198,697,810	193,873
1901	117,140,959	413,896	171,067,229	165,803
1902	118,480,793	422,304	151,169,362	138,552
1903	72,838,011	259,029	147,635,246	134,714
1904	69,657,850	209,509	143,903,175	135,108

Salt imported and entered for consumption in the United States, 1867–1904—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	64,671,139	66,008			623,395,511	1,221,780
1872	57,830,929	60,155			573,700,966	1,161,617
1873	86,756,628	86,193			714,262,877	1,866,596
1874	105,613,913	126,896			891,283,618	2,228,895
1875	110,294,440	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	1,733,559
1878	100,794,611	96,898			867,718,090	1,643,802
1879	94,060,114	95,841			904,106,718	1,778,565
1880	109,024,446	119,667			959,738,849	1,848,174
1881	133,395,065	144,347			1,075,198,397	2,044,958
1882	134,777,569	147,058			863,847,097	1,708,190
1883	142,065,557	154,671			867,915,603	1,641,618
1884	126,605,276	122,463			908,977,803	1,649,918
1885	140,067,018	121,429			903,666,328	1,538,316
December 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	61,563			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			403,465,945	676,324
1902	99,878,031	86,698			369,528,186	647,554
1903	107,487,450	102,205			327,960,707	495,948
1904	118,718,456	122,837			332,279,481	467,754

Salt of domestic production exported from the United States, 1790–1904.

Year ending—	Quantity.	Value.
September 30—	*Bushels.*	
1790	31,935	$8,236
1791	4,208	1,052
1830	47,488	22,978
1831	45,847	26,848
1832	45,072	27,914
1833	25,069	18,211
1834	89,064	54,007
1835	126,230	46,483
1836	49,917	31,943
1837	99,133	58,472
1838	114,155	67,707
1839	264,337	64,272
1840	92,145	42,246
1841	215,084	62,765
1842	110,400	39,064
June 30—		
1843[a]	40,678	10,262
1844	157,529	47,755
1845	131,500	45,151
1846	117,627	30,520
1847	202,244	42,333
1848	219,145	73,274
1849	312,063	82,972
1850	319,175	75,103
1851	344,061	61,424
1852	1,467,676	89,316
1853	515,857	119,729
1854	548,185	159,026
1855	536,073	156,879
1856	698,458	311,495
1857	576,151	190,699
1858	533,100	162,650
1859	717,257	212,710
1860	475,445	129,717
1861	537,401	144,046
1862	397,506	228,109
1863	584,901	277,838
1864	635,519	296,088
1865	589,537	358,109
1866	70,644	300,980
June 30—	*Bushels.*	
1867	605,825	$304,030
1868	624,970	289,936
1869	442,947	190,076
1870	298,142	119,582
1871	120,156	47,115
1872	42,603	19,978
1873	73,323	43,777
1874	31,657	15,701
1875	47,094	16,273
1876	51,014	18,378
1877	65,771	20,133
1878	72,427	24,968
1879	43,710	13,612
1880	22,179	6,613
1881	45,455	14,752
1882	42,085	18,265
1883	54,147	17,321
1884	70,014	26,007
1885	[b] 4,101,587	26,488
December 31—	*Pounds.*	
1886	4,828,863	29,580
1887	4,685,080	27,177
1888	5,359,237	32,986
1889	5,378,450	31,405
1890	4,927,022	30,079
1891	4,448,846	23,771
1892	5,208,935	28,399
1893	5,792,207	38,375
1894	10,853,759	46,780
1895	7,203,024	30,939
1896	10,711,314	43,202
1897	11,593,321	52,320
1898	17,280,193	63,624
1899	25,200,191	86,465
1900	15,021,861	65,410
1901	18,865,247	86,414
1902	10,188,771	55,432
1903	25,499,630	95,570
1904	27,928,088	113,625

[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, 1902, 1903, and 1904. It will be observed that while the value of the salt imported from Great Britain was more than 58.5 per cent of the total value of imports for the year, the quantity received from that country was only about 28.9 per cent of the total amount of salt imported. The West Indies and Italy both exceeded Great Britain in the quantity of salt exported to the United States, but it was all of coarse grades, and consequently of low valuation.

During the fiscal year ending June 30, 1904, the movement of exported salt changed notably from the course of trade in the previous year. Exports to Japan dropped off about 38 per cent, probably on account of her war with Russia, but trade with Mexico more than doubled, and the already large exportation to the Dominion of Canada increased nearly 100 per cent. The total exports of salt during the fiscal year ending June 30, 1904, were 25,508,577 pounds, valued at $99,066, whereas in the year ending June 30, 1903, 16,446,380 pounds were exported at a valuation of $70,296, an increase for 1904 of 55.1 per cent in quantity, but of only 40.9 per cent in value.

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, 1902, 1903, and 1904.

Country from which imported.	Year ending June 30, 1902.		Year ending June 30, 1903.		Year ending June 30, 1904.	
	Dutiable and free.		Dutiable.		Dutiable.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
United Kingdom	151,316,042	$488,652	113,828,493	$349,509	98,943,611	$301,696
Italy	90,826,888	61,137	76,360,106	53,011	106,060,288	75,756
Canada	8,721,684	25,245	8,884,424	26,697	11,102,273	27,529
West Indies	119,448,756	102,964	131,253,695	113,578	105,160,371	89,878
Other countries	11,561,475	10,371	11,816,828	22,171	20,882,959	20,371
Total	381,874,845	688,369	342,143,546	564,966	342,149,502	515,230

Exports of salt during the fiscal years ending June 30, 1902, 1903, and 1904.

Country to which exported.	Year ending June 30, 1902.		Year ending June 30, 1903.		Year ending June 30, 1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*	
United Kingdom	22,000	$500	95,500	$450	314,400	$1,550
Bermuda	196,368	1,874	161,248	1,655	204,380	2,069
British Honduras	13,891	96	15,608	168	229,247	1,067
Dominion of Canada:						
Nova Scotia, New Brunswick, etc	74,680	1,133	63,550	648	53,320	690
Quebec, Ontario, etc	5,073,350	10,761	5,955,665	18,379	13,503,496	31,258
British Columbia	2,267,235	14,030	1,801,030	8,170	1,543,133	6,203
Newfoundland and Labrador	67,140	696	49,500	476	122,110	1,133
Central American States:						
Costa Rica	139,980	1,610	142,661	1,440	164,450	1,564
Guatemala	476,287	2,888	78,528	531	974,306	4,526
Honduras	60,215	706	99,532	827	240,267	1,762
Nicaragua	346,913	2,913	411,767	3,463	384,189	2,978
Salvador	....	....	75,558	485	57,657	249
Mexico	1,728,915	15,873	1,297,004	11,642	2,673,137	22,821
West Indies:						
British	158,875	658	82,199	408	47,446	280
Danish	2,000	26	1,650	25	4,160	33
French	14,102	171	15,887	216	14,775	162
Haïti	3,348	50	6,475	77	1,800	21
Santo Domingo	24,902	336	34,286	462	38,693	435
Cuba	62,965	386	39,699	317	730,021	3,512
Colombia	189,786	1,694	207,810	2,240	166,675	1,253
Japan	454,665	1,546	5,413,425	15,126	3,379,256	10,890
China	....	....	1,810	25	41,800	187
Russia, Asiatic	5,608,750	23,104	182,210	1,119	318,550	1,725
French Oceania	75,348	811	118,800	1,098	97,045	836
British Australasia	215,600	949	2,350	22	....	....
Philippine Islands	....	....	960	13	....	....
British Africa	400	3	10,600	67	8,635	82
Other countries	44,803	450	81,068	747	195,629	1,780
Total	17,322,518	83,264	16,446,380	70,296	25,508,577	99,066

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 1903. The following 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 43,776 short tons, and the output of Great Britain was 87,143 short tons less in 1901 than in 1900. The increase in the production of salt in the United States during 1902, as compared with 1901, amounted to 461,959 short tons, while the production of Great Britain increased 123,581 short tons in the same period. The total output of salt in the United States during 1902 was 57 per cent greater than that of Great Britain for that year.

The year 1902, however, was one of overproduction of salt in the United States, and was followed by strong reaction, so that the production reported for 1903 was 684,359 short tons less than that for the preceding year. The long-continued decrease in the manufacture of salt in the United Kingdom, which was checked in 1902, began again in 1903, and the production for the year was 7,716 short tons less than for 1902. The United States, in spite of the great falling off in her output for 1903, maintained her position at the head of the list of salt-producing countries of the world, about 20 per cent of the grand total of production being hers. The United States produced about 26 per cent more salt than the United Kingdom, the second country in the list. Material increases were reported for 1903 over 1902 by France and Germany. A large decrease was reported for the same period by India. Statistics are not yet available for other countries.

In the following table the statistics of salt production in the principal countries of the world are shown for each year from 1890 to 1903, as far as statistics are obtainable. 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, 1890–1903.

Year.	United States.		United Kingdom.		France. [a]		German Empire.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
1890	1,242,778	$4,752,286	2,403,462	$5,354,400	955,434	$3,458,174	1,157,023	$3,939,877
1891	1,398,312	4,040,839	2,288,800	4,737,596	932,292	2,868,945	1,289,888	4,100,340
1892	1,637,845	5,654,915	2,191,307	4,177,795	1,100,898	3,318,366	1,286,675	4,168,915
1893	1,665,609	4,154,668	2,154,912	3,565,827	1,248,560	3,291,422	1,339,311	4,140,279
1894	1,815,438	4,739,285	2,504,221	3,703,601	1,001,498	2,762,216	1,381,211	4,333,707
1895	1,913,751	4,423,084	2,434,043	3,442,292	988,273	2,421,378	1,332,557	4,336,161
1896	1,939,102	4,040,839	2,265,040	3,233,073	1,178,038	2,492,402	1,436,648	4,417,922
1897	2,236,248	4,920,020	2,131,912	3,017,564	1,070,290	2,236,755	1,440,358	3,838,426
1898	2,465,769	6,212,554	2,103,718	3,016,011	1,132,415	2,156,196	1,510,527	3,954,743
1899	2,759,206	6,867,467	2,144,680	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	2,121,147	2,805,838	982,479	2,605,800	1,745,226	4,992,600
1903	2,655,532	5,286,988	2,113,431	2,967,676	1,096,017	3,036,930	1,867,296	4,587,767

Year.	Japan.		Italy.		Austria-Hungary. [b]	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1890	544,030	(c)	524,552	$999,933	515,736	$17,863,887
1891	616,795	(c)	492,144	927,812	508,022	17,436,392
1892	633,449	(c)	461,738	857,692	490,390	16,069,952
1893	744,717	(c)	466,146	990,283	524,552	16,475,059
1894	708,500	(c)	477,166	912,118	565,326	17,256,516
1895	671,446	(c)	526,370	1,030,350	530,062	17,075,675
1896	586,323	(c)	497,915	935,466	538,951	15,497,873
1897	691,947	(c)	507,778	968,031	554,078	15,725,518
1898	712,878	(c)	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	684,330	4,415,145	505,401	711,400	575,936	16,071,930
1903	724,750	4,692,539	538,480	717,466	571,600	16,180,748

[a] Includes product of Algeria.
[b] Government monopoly.
[c] No value obtainable.

The world's salt production, 1890-1903—Continued.

Year.	Russia.		Spain.		India.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1890	1,531,736	$2,613,611	678,531	$1,750,444	1,159,395	$1,948,104
1891	1,489,008	4,978,589	642,292	1,687,300	1,139,468	1,690,294
1892	1,608,595	4,627,700	750,059	2,505,855	1,008,330	1,750,317
1893	1,489,687	4,281,970	166,913	82,076	940,547	1,546,597
1894	1,493,572	3,317,160	227,645	85,786	1,452,654	2,538,121
1895	1,705,896	3,887,090	359,604	918,775	1,282,522	2,058,678
1896	1,484,782	4,917,250	574,970	1,113,494	1,131,472	1,753,371
1897	1,682,337	4,357,253	560,484	1,118,720	1,033,601	1,560,415
1898	1,642,980	4,255,318	527,858	989,704	1,104,513	1,902,377
1899	1,852,861	2,767,168	659,140	1,052,988	1,031,149	1,637,836
1900	2,169,332	(*a*)	495,965	834,535	1,125,611	1,146,363
1901	1,880,438	3,591,973	380,363	599,934	1,234,839	1,821,764
1902	2,035,969	3,894,162	470,058	682,664	1,231,058	2,481,357
1903	(*b*)	(*b*)	471,116	670,247	921,957	1,495,490

Year.	Canada.		Other countries.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.[c]	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1890	43,754	$198,857	....	....	10,212,401	$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	....	....	10,058,561	38,724,107
1894	57,199	170,687	[d] 2,772	$9,515	10,978,702	39,828,712
1895	52,376	160,455	[e] 159,129	1,155,738	11,284,583	40,909,676
1896	43,960	169,693	[f] 128,959	408,111	11,219,837	38,979,494
1897	51,348	225,730	[f] 35,373	204,468	11,303,807	38,172,900
1898	57,142	248,639	[g] 463,707	1,567,034	12,145,461	44,639,906
1899	59,339	254,390	123,179	755,531	13,194,488	45,524,651
1900	62,055	279,458	81,717	511,737	13,406,777	43,884,980
1901	59,428	262,328	[h] 541,613	2,463,670	13,522,025	45,984,026
1902	63,056	288,581	[i] 125,467	970,522	13,880,018	45,588,635
1903	62,452	297,517	[j] 405,415	[j] 2,099,855	13,464,015	45,927,385

a Value per ton assumed to be the same as in 1899 in making up the total for the world's production for 1900.
b Production and value in 1902 used in making up total for world's production in 1903.
c Not including production of Japan prior to 1899, for which no value is obtainable.
d Cape Colony and Ceylon.
e Cape Colony, Ceylon, Greece, Bosnia, and Herzegovina.
f Cape Colony, Greece, Bosnia, and Herzegovina.
g 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.
h In addition to this quantity, Argentina produced 28,000 short tons; Chile (approximately), 11,000; China (estimated), 250,000; Egypt (estimated), 350,000; Roumania (approximately), 100,000, and Switzerland, 55,766, an aggregate of 694,766 short tons, for which no value is given.
i In addition there were produced probably 1,000,000 short tons in various countries for which no definite statistics are available.
j Approximation.

SULPHUR AND PYRITE.

By Joseph Hyde Pratt.

INTRODUCTION.

In connection with the sulphur industry of the United States, the most noticeable and interesting change during the last year is the exporting of American sulphur, the first cargo having been shipped from Louisiana to Marseille, France. Sicily has controlled largely the world's supply of sulphur, but the development of the Louisiana deposits, which have been put on a commercial and profitable basis since the introduction of the Frasch method of mining the sulphur and which resulted in the first shipment of a 3,000-ton cargo of raw sulphur to France, indicates that American sulphur will share with the Sicilian in the French trade. France requires about 90,000 tons of sulphur a year, which is used largely in connection with the preservation of its grapevines. The American sulphur is very pure, it being estimated that the commercial product is 99.9 sulphur, which makes it possible for it to compete easily with the Sicilian sulphur. Up to the importation by France of the American sulphur the prices received for the Sicilian sulphur were, per 100 kilograms (220.46 pounds) at Marseille, as follows: Third current Sicilian, \$1.89; third good Sicilian, \$1.92; third fine Sicilian, \$1.96; second fine Sicilian, \$2.08.[a] According to the statement of Mr. Robert P. Skinner, United States consul-general at Marseille, France, it is the last-named grade of sulphur for which the important demand exists. The lowest prices at which Sicilian sulphur has been sold in Marseille, so far as Mr. Skinner was able to find any record, were 39 cents less than the prices quoted above, which were offered in 1897 under the stress of exceptional conditions that existed in Sicily. The American sulphur can easily compete with these prices, and its exportation has already caused considerable anxiety amongst the Sicilian producers.

The credit of exploiting the Louisiana deposits and making them a strong factor in the sulphur industry is due to Mr. Herman Frasch, president of the Union Sulphur Company, who was the inventor of the process for mining the sulphur. His introduction of American sulphur into the world's market is another triumph for American perseverance.

[a] U. S. Monthly Cons. Repts. No. 291, December, 1904, p. 277.

Some idea of the sulphur industry can be realized when it is stated that now over 500,000 long tons of sulphur are exported annually from Sicily, of which quantity over one-fourth is shipped to the United States and about one-sixth to France. Since the formation and organization of the Anglo-Sicilian Sulphur Company, which controls a large portion of the sulphur deposits of Sicily, the prices have increased greatly, so that the development of a deposit of sulphur like that in Louisiana and its introduction upon the market in successful competition with the Sicilian sulphur will undoubtedly mean a break in the prices of sulphur.

At the present time the United States is spending over $6,000,000 for sulphur (including sulphur content of pyrite) a year, of which amount over one-half is expended for native sulphur, by far the larger part going to Sicily. Thus, the Louisiana sulphur should play an important part both in the domestic and in the foreign sulphur market. The Sicilian papers are agitating the question as to what effect the entering of the Louisiana sulphur into the world's market will have upon the Sicilian trade, and are taking measures to prepare the Sicilian sulphur interests to meet this competition of American sulphur. United States Consul Heingartner, Catania, Sicily, states that the town council of Porto Empedocle adopted the following resolutions:[a]

1. The minister of agriculture, industry, and commerce should be impressed with the necessity of sending at once a competent technical committee to Louisiana and Mexico in order to make inquiries and report on the extent of the deposits of the mineral, its quantity and quality, the possibilities of its extraction, at what price it could be produced, and to what extent it may damage Sicilian sulphur interests.
2. Our chambers of commerce should be informed of the above and their assistance should be asked in presenting our request to the minister of agriculture, industry, and commerce.
3. The editors of all Sicilian newspapers are requested to publish the above proposal, support it, and make it known to all interested parties, who should also consider the matter and act in such way as to induce the minister to take the necessary steps in favor of Sicilian trade.

Not only are the Sicilian towns agitated, but also the Anglo-Sicilian Sulphur Company, which, at its eighth annual meeting, made the following reference to the sulphur deposits of Louisiana:[b]

Sicily has been until now virtually the sulphur producer of the world, and there has been practically no serious competition from other sources, but we are threatened this year with some further competition from certain mines in Louisiana, where it is claimed that a considerable quantity of sulphur can be produced. Whether these mines will produce all that is claimed for them remains to be seen, and we are, of course, meanwhile carefully watching their position.

The board has made inquiries as to what the Louisiana mines were doing, but it was difficult to obtain information, as the owners had taken every precaution to prevent inquirers from finding out. They had ascertained, however, that in 1902–3 the mines produced about 8,000 tons of sulphur, and there were no figures published as to what they produced in 1903–4. The directors were naturally anxious to ascertain all they could on the subject.

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[a] U. S. Monthly Cons. Repts. No. 291, December, 1904, p. 276.
[b] Ibid., No. 293, February, 1905, p. 176.

The Italian Parliament has also raised similar questions, according to the Italian papers:[a]

ROME, *February 2.*—Baron del Balzo, Italian under secretary of agriculture, replying in the chamber to-day to questions on the subject of the production of Louisiana sulphur and on the measures that the Government intended to adopt for the protection of the Italian sulphur industry, declared that up to the present Italian sulphur could profitably be sold in Marseille, Rotterdam, and Stockholm, where the American Sulphur Company had made its first shipments. For the present, Baron del Balzo remarked, the danger was not very imminent, and did not appear to him to be very serious.

Professor Luzzatti, minister of the treasury, added that the Government looked with great interest upon the production of sulphur in Louisiana. He declared that he was sure that when the deputies who had questioned the Government knew the action of the Government they would feel completely satisfied.

These extracts will give some idea of the feeling in the sulphur trade regarding these Louisiana deposits, and one of two things is inevitable—either the two deposits will continue to be controlled by separate companies and there will be a material reduction in prices, or there will be an international sulphur syndicate formed to control the output of both the Sicilian and the Louisiana sulphur deposits. Thus far the Louisiana deposits are the only ones discovered and exploited that have entered in any way in direct competition with Sicilian sulphur. Besides these deposits of native sulphur, the greatest competitor of the Sicilian sulphur has been pyrite, which, with the large increase in the price of Sicilian sulphur in 1897, began to be imported in much larger quantities and to be mined more extensively in this country for the production of sulphurous acid for use in the manufacture of paper.

Another noticeable change in the sulphur industry has been the large decrease in the importation of sulphur, which, in 1904, was only 129,532 long tons, as compared with 191,033 long tons in 1903, a decrease of 61,501 tons, due in part at least to the development of the Louisiana deposits.

On account of the world's supply of sulphur being obtained almost entirely from one source, search is continually being made for new deposits, and every little while reports come in of new deposits having been discovered, but in many cases they amount to little or nothing. During the last year there have been reports of various sulphur deposits, and the following are noted in addition to those given in the report for 1903:

PERU.

United States Consul Gottschalk, Callao, Peru,[b] writes that a Lima company is interested in the exploitation of sulphur deposits near Sechura, and that it desires to be placed in communication with persons in the United States who are manufacturers of sulphuric acid

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[a] Taken from Mining Journal, London, February, 1905.

[b] U. S. Monthly Cons. Repts. No. 290, November, 1904, p. 125.

and kindred products and who may desire to receive samples of this Peruvian sulphur with a view to future business relations. The company's address is Sociedad Azufrera de Sechura, la Colmea Building, Lima, Peru. It has been requested that in writing to this company the Consular Reports be mentioned.

These sulphur deposits or beds are not far from the Bay of Sechura, in northern Peru, and a railroad some 28 miles long is nearly completed between them and the port of Bayovár, which will soon be made a port of entry. Material has been received at the port for the construction of a 328-foot pier to facilitate loading the company's sulphur. Although these sulphur beds have been known for some time, their distance from the nearest port, Salinas, and the insecurity of that port for discharging operations, made the enterprise a rather difficult one; but the present company, which has large capital back of it, has surmounted this difficulty by the construction of its own railroad and by the steps they have taken toward opening a good harbor at Bayovár.

WYOMING.

A deposit has been recently investigated near Cody, Wyo., in the Shoshone Canyon. These beds are near the Burlington route.

The development of sulphur beds in the western part of the United States is of importance to the owners of vineyards in California, where there is a large consumption of sulphur each year in the protection of the vineyards from certain insects and diseases. This is also the use that is made of the greater part of the sulphur imported into France and Turkey. In a recent report, United States Consul Lane,[a] at Smyrna, Turkey, states that there is a large increase in the demand for sulphur in Turkey, and he suggests that quotations be sent to that market. This present demand for sulphur is due to the rapid spread of phylloxera among the vineyards of Turkey.

SULPHUR.

PRODUCTION.

The combined production of sulphur and of pyrite for the manufacture of sulphuric acid in the United States during 1904 was 333,542 long tons, valued at $3,460,863, as compared with the production of 233,127 long tons, valued at $1,109,818 in 1903, an increase of 100,415 long tons in quantity and of $2,351,045 in value. This very large increase in value is due to the large increase in the production of sulphur in 1904 as compared with 1903. The States producing the sulphur in 1904 were Louisiana and Nevada, with by far the larger part of the production from the former State. The following table

[a] U. S. Monthly Cons. Repts. No. 291, December, 1904, p. 137.

shows the annual production of sulphur in the United States from 1880 to 1904:

Sulphur production of the United States, 1880–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	600	$21,000	1893	1,200	$42,000
1881	600	21,000	1894	500	20,000
1882	600	21,000	1895	1,800	42,000
1883	1,000	27,000	1896	5,260	87,200
1884	500	12,000	1897	2,275	45,590
1885	715	17,875	1898	1,200	32,960
1886	2,500	75,000	1899	4,830	107,500
1887	3,000	100,000	1900	3,525	88,100
1888	....	....	1901	(a)	(a)
1889	450	7,850	1902	(a)	(a)
1890	....	....	1903	(a)	(a)
1891	1,200	39,600	1904	(a)	(a)
1892	2,688	80,640			

[a] See table of pyrite production on page 21.

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. Prior to 1891 accurate statements in regard to the consumption of iron pyrite for this purpose were not available, as the statistics of imports previous to that year did not separate the pyrite imported for this purpose. Pyrite was included prior to 1884 among other sulphur ores, but from 1884 to 1887 it was separately reported. From the small quantities reported, however, it would seem that a considerable quantity was imported under the former classification of sulphur ore, or as iron ore, under which it was classified from 1887 to 1891, unless it contained copper oxide to the extent of 3.5 per cent. Thus any comprehensive review of the growth of the consumption of sulphur and pyrite must necessarily begin with the year 1891, the year in which the total quantity of sulphur used (imported and domestic) was 118,258 long tons.

The sulphur content of the iron pyrite consumed in 1891 was 93,233 long tons, making a total of 211,491 long tons of sulphur consumed. In 1904 the domestic production of sulphur and the sulphur content of the domestic production of pyrite amounted to 220,104 long tons. In this same year the sulphur content of the net imports of pyrite amounted to 190,219 long tons, and the natural sulphur imported was 129,532 long tons, a total of 319,751 long tons of imported sulphur consumed in the United States. The total domestic consumption of sulphur in 1904 was, therefore, 539,855 long tons as compared with

489,184 long tons in 1903, an increase of 50,671 tons. From the 1904 figures should be taken the 3,000 tons of Louisiana sulphur that was shipped to France, and this would make the actual consumption of sulphur in the United States 47,671 long tons more in 1904 than in 1903. The statistics for the years 1893 to 1904, 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 given in the following tables:

Estimated consumption of sulphur in the United States, 1893–1901.

Source.	1893.	1894.	1895.	1896.	1897.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Sulphur:					
Domestic	1,071	446	1,607	4,696	2,031
Imported [a]	105,823	125,459	122,096	139,280	141,905
Sulphur content of pyrite: [b]					
Domestic	34,100	47,673	44,697	51,968	64,440
Imported	87,715	74,596	85,796	90,076	116,796
Total domestic consumption	228,709	248,174	254,196	286,020	325,172

Source.	1898.	1899.	1900.	1901.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Sulphur:				
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.

Consumption of sulphur in the United States, 1902–1904.

Source.	1902.	1903.	1904.
	Long tons.	*Long tons.*	*Long tons.*
Domestic sulphur and sulphur content of pyrite	97,636	108,967	220,104
Imported sulphur	174,939	191,033	129,532
Sulphur content of imported pyrite	196,786	189,184	190,219
Total domestic consumption	469,361	489,184	539,855

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 1860–1903.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1860	155,067	$3,693,036	1882	438,751	$9,002,010
1861	163,217	3,865,950	1883	439,332	8,181,887
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	368,327	5,396,720
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	7,037,859	1902	656,372	12,702,090
1881	367,163	8,088,237	1903	849,007	16,999,673

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 1904, inclusive. This table, and the four tables following, have been compiled from the annual statements published by Mr. Alfred S. Malcomson, of New York:

Total exports of sulphur from Sicily, 1896–1904.

Country.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
	Long tons.	*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	103,189
France	76,739	84,895	88,657	96,043	103,647	74,394	67,634	76,076	104,720
Italy	54,009	73,052	62,652	87,230	101,073	74,516	45,601	45,576	78,694
United Kingdom	21,913	24,520	26,983	25,038	23,973	22,464	25,475	19,209	17,918
Greece and Turkey	18,556	13,866	24,808	18,656	19,647	21,702	20,499	22,168	25,377
Portugal	12,001	7,054	8,257	12,269	10,937	11,335	12,842	18,324	12,434
Russia	18,752	17,532	12,285	19,211	22,090	15,110	17,294	15,068	15,142
Germany	15,680	19,721	27,048	25,933	28,702	23,448	25,908	32,569	31,612
Austria	13,799	15,993	15,796	18,519	21,594	18,842	19,085	17,925	23,374
Spain	5,910	4,039	3,233	7,757	6,187	2,979	....	....	....
Belgium	7,527	9,253	8,402	7,481	9,721	7,471	12,322	14,310	13,627
Holland	3,834	3,599	5,646	6,408	18,595	10,848	8,648	5,160	8,121
Sweden, Norway, and Denmark	14,540	11,226	12,331	12,476	22,681	24,486	24,918	28,290	20,110
Other countries	8,562	7,651	12,791	13,569	6,810	9,887	18,171	23,680	28,949
Total	396,745	410,538	447,324	479,031	558,162	462,299	467,317	475,423	478,267

IMPORTS.

The sulphur imported into the United States is produced principally in Sicily and Japan, with very small quantities from 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, 1867–1904.

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
December 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	12,609	159,213	3,069,924
1899	140,182	2,484,801	335	9,917	184	4,519	832	23,966	2,523,203
1900	166,825	2,917,172	628	17,437	243	6,279	16	2,106	2,942,994
1901	174,160	3,256,990	748	20,201	268	6,308	33	4,407	3,287,906
1902	170,601	3,334,002	738	19,954	14	369	27	3,325	3,357,650
1903	188,990	3,649,756	1,854	52,680	160	3,746	29	3,508	3,709,690
1904	127,996	2,462,360	1,332	39,133	163	4,373	41	5,403	2,511,269

[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 1904, inclusive. Canada and England, which are given in these tables 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, 1900–1904.

Countries whence exported and customs districts through which imported.	1900.		1901.		1902.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
COUNTRY.	*Long tons.*		*Long tons.*		*Long tons.*	
Canada	....	....	933	$24,957	776	$18,631
England	7,425	$155,882	7,484	156,205	7,681	161,387
Italy	138,011	2,369,037	139,492	2,474,684	163,571	3,111,971
Japan	9,958	186,847	11,798	219,193	15,448	290,826
Other countries	5	146	4	65	4	69
Total	155,399	2,711,912	159,711	2,875,104	187,480	3,582,884
DISTRICT.						
Baltimore, Md	12,798	213,893	9,040	153,664	12,137	225,804
Boston and Charlestown, Mass.	10,023	203,014	11,048	217,274	12,124	251,366
New Orleans, La	1,000	16,111	2,213	54,694	....	....
New York, N. Y	85,885	1,467,947	89,756	1,585,084	100,109	1,891,554
Philadelphia, Pa	7,448	120,284	11,100	185,319	16,719	304,777
Portland, Me	24,880	436,692	20,039	363,473	30,032	596,931
San Francisco, Cal	8,237	152,335	9,359	172,176	10,497	200,255
Savannah, Ga	751	13,675	1,000	18,190	....	....
Vermont, Vt	....	....	439	12,285	....	....
Willamette, Oreg	1,630	33,134	2,087	40,515	3,475	63,696
All other	2,747	54,827	3,630	72,430	2,387	48,501
Total	155,399	2,711,912	159,711	2,875,104	187,480	3,582,884

Countries whence exported and customs districts through which imported.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
COUNTRY.	*Long tons.*		*Long tons.*	
Canada	....	....	1	$25
England	10,060	$214,456	7,030	157,251
Italy	153,782	2,997,908	149,383	2,833,269
Japan	16,167	315,833	11,654	218,366
Other countries	1,121	21,173	1,104	22,712
Total	181,130	3,549,370	169,172	3,231,623
DISTRICT.				
Baltimore, Md	11,984	232,780	11,650	223,489
Boston and Charlestown, Mass	14,362	303,548	19,980	407,811
New Orleans, La	609	19,889	....	....
New York, N. Y	98,855	1,917,523	79,119	1,471,412
Philadelphia, Pa	11,635	219,081	16,178	307,508
Portland, Me	26,559	522,291	31,270	611,752
San Francisco, Cal	10,523	208,539	8,310	158,806
Savannah, Ga	....	....	....	....
Vermont, Vt	....	....	....	....
Willamette, Oreg	4,151	76,283	1,368	28,365
All other	2,452	49,436	1,297	22,480
Total	181,130	3,549,370	169,172	3,231,623

WORLD'S PRODUCTION.

The following table shows the estimated quantity of sulphur produced by all countries for the years 1899 to 1903, inclusive:

World's production of sulphur, 1899–1903.

Country.	1899.		1900.		1901.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Metric tons.		*Metric tons.*		*Metric tons.*	
United States	4,383	$107,500	3,199	$88,100	6,976	$223,430
Austria	555	1,526	862	2,256	4,911	12,107
France	11,744	28,884	11,551	26,427	7,000	16,400
Germany	1,663	36,000	1,445	31,000	963	20,250
Greece	1,237	22,266	891	16,038	3,212	67,290
Hungary	116	3,600	123	3,820	137	3,847
Italy	554,638	10,392,415	544,119	10,212,903	563,096	10,734,192
Japan	10,235	211,735	14,435	155,932	16,578	192,465
Russia	451	9,412	1,587	....	2,489	69,945
Spain	1,100	31,350	750	18,000	610	13,115
	a 58,922	102,150	a 64,364	a 109,947	a 49,856	57,236
Sweden	....	....	70	1,890	Nil.	....
Total	645,044	10,946,838	643,396	10,666,313	655,828	11,410,277

Country.	1902.		1903.	
	Quantity.	Value.	Quantity.	Value.
	Metric tons.		*Metric tons.*	
United States	(b)	....	(b)	....
Austria	3,721	$18,121	(c)	....
France	8,000	18,914	7,400	$15,015
Germany	(c)	....	(c)	....
Greece	1,391	24,162	1,400	24,375
Hungary	105	2,947	135	3,816
Italy	a 3,581,671	8,131,732	a 3,690,532	8,541,225
Japan	18,287	219,993	22,914	284,660
Russia	18,000	53,557	(c)	....
Spain	....	....	38,600	41,730
	a 15,442	38,736		
Sweden	74	1,983	(c)	....
Total	3,646,691	8,510,145	3,760,981	8,910,821

a Crude rock. b Included with pyrite. c Statistics not available.

PYRITE.

The domestic sources of supply of pyrite, such as is used in the manufacture of sulphuric acid and in the wood-pulp industry, are obtained chiefly from Virginia, California, and Massachusetts, with smaller amounts from Alabama, Georgia, Indiana, New Jersey, and Ohio. The deposits in these States do not begin to supply the demand for pyrite, and there is usually a considerably greater quantity imported than is produced in this country. The chief sources of supply of the imported pyrite are the celebrated Rio Tinto and Tharsis mines of the Huelva district in Spain; the San Domingo mine at Pomaron, Portugal, and the Tilt Cove mines of Pilley's Island, Newfoundland.

The demand for pyrite has increased very largely throughout the United States and many European countries during the last few years not only for use in the manufacture of fertilizers, but also in the wood-pulp industry, its use for the latter purpose demanding at the present time in the United States a considerable quantity of this mineral. Owing to this steady increase in the demand, it is not improbable that prices will gradually advance for the best qualities of ore. From all accounts, the pyrite industry in Spain has reached a point where the shipping facilities are inadequate to handle the production. In order to increase the shipping facilities at the port of Huelva and to expedite the loading of steamers, the Spanish Government is erecting a new dock at this port. Although these Spanish deposits are enormous and new bodies of ore have been uncovered during the last year or two, there is still such a large and steady drain upon them that some of the European countries are beginning to look elsewhere for supplies of pyrite. On account of the rapid increase in the manufacture of fertilizer in Spain, Italy, and France, these countries are making large demands upon the Spanish pyrite for use in the manufacture of sulphuric acid.

According to United States Consul-General Mason at Berlin, Germany, the important German manufacturers of sulphuric acid, who have hitherto been mainly supplied with pyrite from Spain and Portugal, are now beginning to look to other countries for at least a part of their supplies, and it is suggested by Mr. Mason that he will give owners of pyrite mines in the United States who are prepared to export their product in any quantity direct information concerning connections in Germany if they will consult with his consulate.[a]

It is doubtful, however, if there would be any American pyrite for exportation unless there is a considerable increase in the price of this mineral, for many deposits of pyrite of good grade in the United States are not now worked, on account of their not being able to compete at present prices with foreign pyrite nor with more favorably located domestic deposits. Then again, those deposits that are now worked do not begin to supply the demand for this mineral in the United States, and the imports are nearly double the domestic production.

New deposits of pyrite in Alabama have recently become available by the completion of the Eastern Railroad of Alabama from Talladega to Pyriton. For this material there should be a large demand at Nashville, Tenn., as a source of raw material for its fertilizer factories. These Nashville fertilizer factories are advantageously located,

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[a] U. S. Monthly Cons. Repts., No. 286, July, 1904, p. 23.

with reference to the Tennessee phosphate fields, and having now easy access to these Alabama pyrite deposits, they should be able to compete readily with any of the fertilizer plants.

This anxiety regarding the source of supply of pyrite on the part of European countries should stimulate prospecting for and development of pyrite deposits in this country in order to determine accurately future sources of supply of this mineral in this country in case the present foreign sources of supply of over one-half of the domestic consumption should begin to give out or there should be too heavy a demand upon them by European countries.

PRODUCTION.

There was a slight decrease in the production of pyrite for the manufacture of sulphuric acid in the United States during 1904, but a very large increase in the production of natural sulphur, the combined production amounting to 333,542 long tons, valued at $3,460,863, as compared with 233,127 long tons, valued at $1,109,818, the production of 1903, an increase of 100,415 tons in quantity and of $2,351,045 in value. This exceptionally large increase in value, as compared with the increase in tonnage, is due to the very large increase in the production of sulphur. Besides the pyrite included in this production, there is a considerable quantity of this mineral 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 1904 production of pyrite was obtained from the following States, given in the order of their respective outputs: Virginia, California, Massachusetts, Georgia, Alabama, Indiana, Ohio, and New Jersey. Of the total production of pyrite, over one-half was obtained from Virginia. South Dakota, which had a production in 1903, did not report any in 1904. The average price received for the 1904 production was $3.86 per ton, an increase of 24 cents as compared with $3.62, the average price received for the 1903 production. As compared with $4.28, the average price received per ton for the 1902 production, this is a decrease of 42 cents per ton. The average value per ton of the imported pyrite was $3.63, or 23 cents less than the average price of the domestic production. The average 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, but decreased in 1904 to $3.63.

In the table following are given the quantity and value of the pyrite mined for its sulphur content in the United States since 1882, there being included with this for the years 1901 to 1904, inclusive, the quantity and value of the production of sulphur:

Production of pyrite in the United States, 1882–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Long tons.			*Long tons.*	
1882	12,000	$72,000	1894	105,940	$363,134
1883	25,000	137,500	1895	99,549	322,845
1884	35,000	175,000	1896	115,483	320,163
1885	49,000	220,500	1897	143,201	391,541
1886	55,000	220,000	1898	193,364	593,801
1887	52,000	210,000	1899	174,734	543,249
1888	54,331	167,658	1900	204,615	749,991
1889	93,705	202,119	1901	[a] 241,691	1,257,879
1890	99,854	273,745	1902	[a] 207,874	947,089
1891	106,536	338,880	1903	[a] 233,127	1,109,818
1892	109,788	305,191	1904	[a] 333,542	3,460,863
1893	75,777	256,552			

[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, 1884–1904.[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	1,636,450
1895	190,435	673,812	1904	422,720	1,533,997

[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.

CONSUMPTION.

It will be observed that in the fourteen 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 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, 1891–1901.

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.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*
Domestic product	193,364	174,734	204,615	241,691
Imports	252,773	269,868	322,484	403,706
Domestic consumption	446,137	444,602	527,099	645,397
Sulphur displaced, estimated on basis of 45 per cent content	200,762	200,071	237,195	290,430

Quantity of pyrite and sulphur consumed in the United States and the actual amount of sulphur consumed, estimating the amount of sulphur displaced by the pyrite, 1902–1904.

Source.	1902.	1903.	1904.
	Long tons.	*Long tons.*	*Long tons.*
Domestic product of pyrite and sulphur	207,874	233,127	333,542
Imports of pyrite	446,363	420,410	422,710
Imports of sulphur	174,939	191,033	129,532
Total production	829,176	844,570	885,784
Less exports	3,060	....	3,000
	826,116	....	882,784
Total combined consumption of sulphur, estimating sulphur in pyrite on basis of 45 per cent content	469,361	489,184	539,855

CANADIAN PRODUCTION.

The Canadian production of pyrite in 1904 amounted to 33,039 tons, valued at $94,797, a decrease of 491 tons in quantity and of $31,336 in value as compared with the production of 33,530 tons, valued at $126,133, in 1903. In the following table is shown the quantity and value of pyrite produced in Canada from 1886 to 1904, inclusive:

Annual production and value of pyrite in Canada, 1886–1904.

Calendar year.	Quantity.	Value.	Calendar year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1886	42,906	$193,077	1896	33,715	$101,155
1887	38,043	171,194	1897	38,910	116,730
1888	63,479	285,656	1898	32,218	128,872
1889	72,225	307,292	1899	27,687	110,748
1890	49,227	123,067	1900	40,031	155,164
1891	67,731	203,193	1901	35,261	130,544
1892	59,770	179,310	1902	35,616	138,939
1893	58,542	175,626	1903	33,530	126,133
1894	40,527	121,581	1904	33,039	94,797
1895	34,198	102,594			

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 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 the 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 considerably more reliable.

World's production of iron pyrite and quantity of sulphur displaced, 1892–1903.

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

[a] Exports, except 1896. [b] Based on estimated 45 per cent of sulphur content.

World's production of iron pyrite and quantity of sulphur displaced, 1892–1903—Cont'd.

Country.	1898.	1899.	1900.	1901.	1902.	1903.
	Long tons.	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*	*Long tons.*
Spain [a]	255,896	316,212	350,296	393,397	142,708	153,543
France	306,002	313,087	300,170	302,605	313,204	[b] 324,212
Portugal	244,229	271,228	339,892	331,641	407,173	407,480
United States	193,364	174,734	204,615	234,825	207,874	233,137
Germany	134,650	142,299	166,724	154,954	162,613	168,307
Norway	88,320	94,099	97,387	100,283	101,016	(c)
Hungary	57,146	78,241	85,602	92,428	104,806	95,097
Italy	66,120	75,308	70,465	87,969	91,704	99,857
Canada	28,766	24,721	35,742	31,483	31,800	33,039
Newfoundland	32,335	26,154	Nil.	7,532	26,000	42,000
Russia	24,175	22,877	22,789	30,248	26,047	(c)
United Kingdom	12,102	12,230	12,279	10,241	9,168	9,645
Bosnia and Herzegovina	236	423	1,673	4,498	5,088	6,484
Belgium	145	278	394	....	699	709
Sweden	380	148	176	Nil.	....	7,670
Total	1,443,866	1,552,039	1,688,204	1,782,104	1,629,900	1,581,180
Sulphur displaced [d]	649,739	698,418	759,692	788,335	676,277	....

[a] Exports, except in 1896.
[b] Includes Algeria.
[c] Statistics not yet available.
[d] Based on estimated 45 per cent of sulphur content.

BARYTES.

By Joseph Hyde Pratt.

INTRODUCTION.

The value of barytes as a white pigment is being recognized more and more each year; and although there may be very little, if any, that is used alone for this purpose, it is used in large quantities to mix with white lead, zinc white, or a combination of both of these white pigments. This addition is not as an adulterant, as was the case a few years ago, for it is now appreciated that the addition of barytes makes a white pigment more permanent, less likely to be attacked by acids, and freer from discoloration than when white lead is used alone. It is also believed that the barytes gives greater body to the paint and makes it more resistant to the influences of the weather. As is well known, pure white lead, when it remains in the shade or in a dark place, becomes discolored, turning yellowish, while mixtures of white lead and zinc white, or of white lead and barytes, or of white lead, zinc white, and barytes retain their color permanently even in dark places.

There is considerable variation in the barytes prepared for market, and it would seem to be well to establish some standard for barytes that is to be used in the manufacture of a white pigment, for a number of the impurities that are apt to occur in barytes, as silica and lime, as well as traces of iron oxide and of manganese dioxide, are highly undesirable as ingredients of paint. These variations in the quality of barytes are known and appreciated by those who grind the mineral and prepare it for market, but the purchasers of this material for pigments or other purposes have not acquainted themselves with these variations and have usually paid but little attention to testing the product. The barytes should be tested chemically in order to determine its percentage of silica, which would represent the grit contained; also its percentage of lime, iron, and manganese. In a first-grade barytes there should be no calcium carbonate, silica, free iron oxide, or free manganese dioxide. It would be well to note not only the color of the dry powder, as compared with some standard sample, but also the color after it has been rubbed down in refined linseed oil. Occasionally samples of barytes will be found that on grinding with oil assume a grayish or even a reddish shade. Another point to be considered is the quantity of oil required to grind the barytes to a paste. In general, the inferior grades of barytes require more oil for this purpose.

Many of the minerals which occur with barytes can be eliminated during the mining and in the first steps in cleaning the barytes. The common associated minerals of barytes in the large deposits are galena, quartz, calcite (calcium carbonate), limonite (hydrated ferric oxide), either massive or as thin stains on the barytes, and manganese dioxide. Of these minerals, most of the quartz can be eliminated by hand-cobbing the ore as it is mined, and this is also true of a large part of the calcite (which for the most part occurs in the form of limestone), and of the massive limonite. In sorting the lump ore as it is mined, that showing streaks of quartz should be eliminated from the first-grade ore. The iron-stained barytes can sometimes be so cobbed that only a small amount of the stained lumps go into the first-grade material. It is the occurrence of these iron stains that necessitates the bleaching of the greater portion of the barytes that is mined. Much of that mined in Germany is ground and prepared for market without any bleaching, and this is also true of some of the barytes produced in this country. The bleaching process, while not an elaborate one, adds considerably to the cost of production of the first grade of barytes. Where the ore contains considerable galena, in rather large masses, the bulk of it can usually be removed during the process of hand-cobbing the ore; if it occurs as small particles scattered through the barytes, it can usually be almost entirely removed by jigging after the ore has been crushed to one-fourth or one-half mesh. The iron minerals that occur in the barytes may sometimes also be entirely removed in this same manner.

CLEANING THE BARYTES.

After the ore has been hand-cobbed at the mine into one, two, three, or four grades it is shipped to the mills, where it is further cleaned by crushing and washing to remove as many impurities as possible. The next process is known as bleaching. The ore is crushed to a size varying from that of a pea to half an inch, according to the extent of iron oxide that it may contain and whether this oxide is in the form of scales or as a stain. If as the former, it can often be removed, as stated above, by jigging.

Mr. Edwin Higgins, jr., has recently published an article in the Engineering News on The Bleaching of Barytes.[a]

In bleaching the barytes, the crushed mineral is placed in wooden tanks lined with sheet lead and holding from 5 to 25 tons of mineral. The tanks used are either circular or rectangular, the former being preferable for the reason that the steaming can be more uniformly done. The best size is 4½ feet high and 8 feet in diameter. With a tank of this size, one steam inlet is required. The most satisfactory

[a] Eng. News, February 23, 1905; and Eng. and Min. Jour., vol. 79, 1905, p. 465.

tanks are made of stout, well-seasoned cypress wood, which are well braced on the outside and lined on the inside with heavy sheet lead. A lead coil of pipe one-half to 2 inches in diameter is constructed in such a manner that either steam or water can be supplied through the perforations which are best located at an angle of about 45° to the verticle diameter of the pipe rather than directly on top of the pipe. With the perforations in this position there is less chance of the holes becoming clogged up by fines dropping into them. In charging the tanks the barytes is added to a depth of about 3 feet and then the dilute sulphuric acid solution, which is used as the solvent, is run in. Steam is admitted by means of the coiled lead pipe, which is clósed at one end and provided with small perforations from 6 to 8 inches apart. The steam escaping from these perforations agitates and heats the mixture, which requires from six to eighty hours to bleach, depending entirely on the amount of iron contained in the barytes. After drawing off the acid, the cleaned mineral is discharged either by sluicing through a specially constructed spout or else by shovelling over the side of the tank and is transferred to a washer in which the last traces of the acid and clay material are removed. The cleaned mineral is then dried either on large pans or by means of some one of the patented rotary driers.

In this bleaching process the manganese dioxide is not removed and the barytes that contains this impurity has to be ground to paste on a 40-mesh screen and then mixed with nitrate of soda, salt, and sulphuric acid in the proper proportions. This mixture is then heated in a specially constructed furnace by which process the iron and manganese are converted into chlorides, which, being very soluble in water, can be completely removed by washing, the barytes being allowed to settle in a series of tanks, generally three in number.

The next step in the preparation of the barytes for market is reducing it first to the size of fine sand by means of rolls and then to an impalpable powder by means of buhrstones, after which it is ready to be packed for shipment.

SOURCES OF SUPPLY.

All the barytes produced in the United States during 1904 was obtained from the same localities as during the preceding year. The chief source of supply is still the State of Missouri, the deposits being located in Washington, Cole, Miller, and Crawford counties, with the largest production from the first-named county. The supply obtained from this State was approximately the same as in 1903. The Tennessee deposits are in Bradley, Monroe, Loudon, Cocke, and Greene counties, but these deposits were not worked as extensively in 1904 as in the previous year. In North Carolina the deposits are in Madison and Gaston counties, with the larger production from the former. In

Virginia the barytes deposits are in Bedford, Pittsylvania, Campbell, and Tazewell counties. For several years North Carolina and Virginia have supplied nearly the same quantity of barytes per year. No new mines or properties have been opened in either of these States during the past year. In Kentucky barytes has been found in Caldwell and Lincoln counties, but it was only mined in the former county during 1904, the production being very small. The Illinois deposits, which are in Hardin County, were not producers of barytes during 1904.

A brief paper by Mr. George W. Stose[a] has recently been published by the United States Geological Survey on barite in southern Pennsylvania.

According to this article numerous scattered and little-developed deposits of barytes occur on the eastern side of the Cumberland Valley, in southern Pennsylvania, in the vicinity of Waynesboro, Franklin County. The rocks of this region, consisting of quartzite overlain with limestone, are extensively folded, and these folds have important relations to the deposits of barytes. The barytes is associated with the lowest portions of the limestones and in the sandy layers occurring with them. It is usually found in the red-clay residuum, such deposits being discovered in plowing. A number of tons of barytes were shipped from a number of small openings several years ago, but there have been no extensive deposits developed here. Some of the barytes is found in bed rock where it is chiefly massive, sometimes resembling chert and at other times being clear and crystalline. It occurs as a vein filling in the brecciated limestone and not in large masses. The occurrence of the barytes is in the folded and brecciated portions of the limestone and, in one case at least, in the arch of a plunging anticline associated with the hard sandstone at the top of the lower division, a favorable position for the brecciation of the limestone. The barite was deposited in the crevices of the breccia, cementing it together, and it appears to be due to local segregation of disseminated barite from the adjacent limestone. No barytes deposits of any extent have been developed in this region, and there has been but little development work done.

PRODUCTION.

In 1904 the production of crude barytes in the United States amounted to 65,727 short tons, valued at $174,958 at the mines. This represents the crude barytes after being taken out and hand-cobbed, ready for shipment to the mill. This production is an increase of 15,330 tons in quantity and of $22,808 in value, as compared with the production of 1903, which was 50,397 short tons, valued at $152,150.

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[a] Bull. U. S. Geol. Survey No. 225, 1905, p. 515.

The average value per ton of the 1904 production was $2.66, which is 36 cents less than the average value per ton ($3.02) of the production of 1903, and this in turn was 27 cents less than the average value per ton ($3.29) of the production of 1902. The production of 1904 was obtained from Missouri, Tennessee, North Carolina, Virginia, and Kentucky, given in the order of the importance of their production, Missouri being the largest and Kentucky the smallest producer. In the following table are given the quantity and the value of the production of barytes in the United States in 1902, 1903, and 1904, by States:

Production of crude barytes in 1902, 1903, and 1904, by States.

State.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
Missouri	31,334	$104,677	23,178	$77,712	25,498	$75,552
North Carolina	14,679	44,130	6,835	21,347	13,413	33,930
Tennessee	3,255	14,647	[a]14,684	32,691	[a]15,602	34,024
Virginia	12,400	39,700	5,700	20,400	11,214	31,452
Total	61,668	203,154	50,397	152,150	65,727	174,958

[a] Includes the small production of Kentucky.

As is seen from this table, there was a large increase in the production of North Carolina and Virginia in 1904, the output being nearly double that of 1903, while the outputs of Missouri and Tennessee were only slightly increased.

The total annual production of crude barytes in the United States since 1882, together with the average price per ton, are given in the following table:

Production of crude barytes, 1882–1904.

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	1894	23,335	$86,983	$3.73
1883	30,240	108,000	3.57	1895	21,529	68,321	3.17
1884	28,000	100,000	3.57	1896	17,068	46,513	2.73
1885	16,800	75,000	4.46	1897	26,042	58,295	2.23
1886	11,200	50,000	4.46	1898	31,306	108,339	3.50
1887	16,800	110,000	[a]6.55	1899	41,894	139,528	3.33
1888	22,400	75,000	3.35	1900	67,680	188,089	2.78
1889	21,460	106,313	[b]4.95	1901	49,070	157,844	3.22
1890	21,911	86,505	3.95	1902	61,668	203,154	3.29
1891	31,069	118,363	3.81	1903	50,397	152,150	3.02
1892	32,108	130,025	4.05	1904	65,727	174,958	2.66
1893	28,970	88,506	3.06				

[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, with 67,680 tons, valued at $188,089; but the year of greatest value was 1902, when the output of 61,668 tons was valued at $203,154. In 1900 the average price per ton of the barytes was $2.78; in 1902 the average value was $3.29 per ton; in 1904, however, the average value had decreased to $2.66 per ton. These variations in the value per ton of the barytes are due largely to the greater or less quantity of the No. 1 barytes that is mined. It is also due to a general slight decrease in the value of the crude barytes of all grades.

After the barytes has been cleaned, bleached, and ground ready for use as a pigment, its value is increased from $2 to $4 per ton to $7 to $12 per ton.

IMPORTS.

There is still a certain quantity of crude barytes imported into the United States, principally from Germany, with occasionally a small amount from Newfoundland. During the last few years the quantity and value of these imports have been steadily increasing, and in 1904 they amounted to 5,920 short tons, valued at $48,658, of manufactured barytes, an average value of $8.20 per ton, and to 6,689 short tons of crude barytes, valued at $27,363, an average value of $4.09 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:

Barytes imported and entered for consumption in the United States, 1867–1904.

Year ending—	Manufactured.		Unmanufactured.	
	Quantity.	Value.	Quantity.	Value.
June 30—	*Pounds.*		*Pounds.*	
1867	14,968,181	$141,273		
1868	2,755,547	26,739		
1869	1,117,335	8,565		
1870	1,684,916	12,917		
1871	1,385,004	9,769		
1872	5,804,098	43,521		
1873	6,939,425	53,759		
1874	4,788,966	42,235		
1875	2,117,854	17,995		
1876	2,655,349	25,325		
1877	2,388,373	19,273		
1878	1,366,857	10,340		
1879	453,333	3,496		
1880	4,924,423	37,374		
1881	1,518,322	11,471		
1882	562,300	3,856		
1883	411,666	2,489		
1884	3,884,516	24,671	5,800,816	$8,044
1885	4,095,287	20,606	7,841,715	13,567
December 31—				
1886	3,476,691	18,338	6,588,872	8,862
1887	4,057,831	19,769	10,190,848	13,290
1888	3,821,842	17,135	6,504,975	9,037

Barytes imported and entered for consumption in the United States, 1867–1904—Continued.

Year ending—	Manufactured.		Unmanufactured.	
	Quantity.	Value.	Quantity.	Value.
	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	14,322
1903	5,716	48,726	7,105	22,777
1904	5,920	48,658	6,689	27,363

[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 1904 other barium compounds to the value of $242,804. The table below gives the kind and value of the imports of these various barium compounds in 1902, 1903, and 1904.

Value of the imports of other barium compounds in 1902, 1903, and 1904.

Barium compound.	1902.	1903.	1904.
Witherite, barium carbonate	$12,777	$35,762	$46,133
Barium binoxide	66,746	84,549	102,076
Barium chloride	46,905	68,762	43,694
Blanc fixe, or artificial barium sulphate	25,933	35,466	50,901
Total	152,361	224,539	242,804

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 their production.

STRONTIUM.

During 1904 there was a new deposit of celestite (strontium sulphate) developed by Mr. R. C. Walker, of Austin, Tex. This deposit is located west of Austin, in the Mount Bonnell and Mount Barker district, and has been mentioned in the reports of the Texas Geological

Survey.[a] This district has also been more recently described by Mr. R. T. Hill.[b]

The formation in which this celestite occurs has been designated as the Glen Rose formation, which consists largely of even-bedded strata of different thicknesses of argillaceous, arenaceous, chalky limestones, alternating with thin strata of marly, arenaceous clay. The thickness of the individual beds is remarkably uniform throughout its extent as far as the outcrops could be traced. The stratification of these beds is very conspicuous on account of the manner in which they are weathered. The alternating beds of soft marls and hard limestones have weathered into numerous small cliffs and stratum plains. The lower and upper portions of these Glen Rose formations are thin-bedded alternations of marl and indurated strata, while the middle portion is composed of thicker and more massive indurated beds, which make steep canyon walls when cut by streams.

As stated by Mr. Hill, these rocks contain undeveloped beds of Epsom salts, strontianite, and other materials. The magnesium limestones are soft and of a rich cream or yellow color, and alternate with softer marls of similar composition, sometimes accompanied by pockets or crystalline nodules composed of calcite, arragonite, strontianite, and celestite. These mineral deposits are well developed about 50 feet below the summit of Mount Bonnell.

In developing these deposits it has been necessary to blast the rock, although it is rather soft, and, as described by Mr. Walker, the celestite is found in cleavable masses from half a pound to 100 pounds in weight, and of irregular shapes. He has been working around the hill and expects later to tunnel into it. The deeper he has extended his workings into the hill the purer and more abundant is the celestite obtained, the color of which varies from white to pale bluish gray.

Samples of this celestite have been analyzed by Messrs. Ledoux & Co., of New York City, who reported the sample as containing, after drying at 212° F., 97.64 per cent of strontium sulphate. It was also analyzed by the mineral department of the University of Texas, which reported 98 per cent of strontium sulphate.

During 1904 one carload of 17 tons of this mineral was mined and shipped to Germany. The value of celestite varies from $20 to $50 per ton.

There were no other deposits of strontium minerals developed in the United States during 1904, nor any mineral mined from any of the other United States deposits.

There were no strontium salts imported into the United States during 1904.

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[a] First Rept. Geol. Survey Texas, 1889, p. 125, and Third Rept. Geol. Survey Texas, 1891, p. 299.
[b] Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 7, 1899-1900, pp. 144-147.

MINERAL PAINTS.

By Joseph Hyde Pratt.

INTRODUCTION.

Under the head of mineral paints are included those substances that are mined and prepared primarily for use as pigments. 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 rich in iron, which are used for yellow and brown pigments, such as ocher, umber, sienna, etc., and which contain from 10 to 50 per cent of iron oxide; barytes, or heavy spar, used for white pigments; slate or shale; and graphite. There are a number of other minerals that are directly used in the manufacture of paints, such as asbestos and soapstone, these two being utilized principally in the manufacture of fireproof paints and paste; and still others that are used either as adulterants or as fillers, as gypsum, quartz (silica), feldspar, and pipe clay. These latter materials, together with whiting, talc, and asbestos, are known in the paint trade as "extenders" and they represent inert materials that have been added to the paint.

Under this class barytes has been included for a great many years, as it was first added to paints when sold by weight to increase the weight. With the introduction of this material into paint, the question at once arose as to whether or not its presence was objectionable otherwise than in increasing the weight or the volume of the paint, according as to the way in which it is sold. In a great many of the paints now on the market, more or less of this material is used. The barytes, which makes a white pigment, will mix by itself readily with linseed oil and make a paint that covers a surface smoothly and evenly and that wears probably even better than white lead. Combined with white lead, although it increases the weight, it makes in the end a better pigment in many respects than white lead alone, and if the white lead is sold by volume instead of by weight, there can be no objection whatever to the barytes being mixed with it.

Talc and asbestos are used principally in those paints that are manufactured as fireproofing paints. In many of the ochers there is more or less silica, but this does not seriously interfere with the ochers as pigments, provided there is at least 20 per cent of iron oxide in the pigment. Quartz (silica) is practically unalterable in the atmosphere and is not attacked by oils or gases, so that its presence does not affect the pigment chemically, and, on the other hand, it brightens some of the iron pigments. The most serious effect of silica is in grinding the pigment. Gypsum is used in connection with many venetian reds and red oxides. It does not have any injurious effect upon the pigments and does act as an extender, and it has a brightening tendency in the case of venetian reds.

Whiting or lime is often used in the manufacture of the very cheap red pigments by mixing copperas (sulphate of iron) with the lime or whiting and then heating the mixture in a furnace. The iron sulphate and lime react, forming iron oxide and calcium sulphate.

Of the above-mentioned minerals, the only ones that are treated in this report are ocher and other iron earths which give the ocher, umber, and sienna pigments; the iron ores which give metallic paint; zinc white; and slate. Graphite, talc, asbestos, and barytes are included in the general reports on those subjects. Besides these minerals 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.

In 1903 the total production of the natural pigments, consisting of metallic paint and mortar colors, ocher, umber, sienna, venetian red, zinc white, slate, and carbonaceous shales and schists, amounted to 123,148 short tons, valued at $5,439,653, as compared with the production of 126,649 short tons, valued at $5,437,275 in 1903, a decrease of 3,501 short tons in quantity, but an increase of $2,378 in value.

There is given in the following table the production of the various mineral paints for the years 1897 to 1904, inclusive:

Production of mineral paints, 1897–1904.

Kind.	1897.		1898.		1899.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Ocher	14,006	$162,764	11,963	$123,832	14,124	$140,168	17,015	$186,707
Umber	[a] 1,080	11,710	[b] 1,177	8,285	473	4,151	1,452	26,927
Sienna	620	10,610	689	11,140	588	8,205	957	14,771
Metallic paint	16,699	187,694	20,972	263,979	23,423	249,945	23,218	261,831
Mortar color	8,237	75,570	7,107	74,894	5,736	65,156	6,689	79,911
Venetian red	13,603	294,744	10,271	160,711	11,991	210,361	14,696	236,574
Zinc white	25,000	1,750,000	33,000	2,310,000	40,146	3,211,680	48,840	3,667,210
Soapstone	2	20	100	800	100	700	100	700
Slate [c]	4,666	46,681	4,571	46,215	4,676	43,703	6,395	53,942
Other colors	2,000	6,000	2,000	6,000	2,000	6,000	1,700	20,000
Total	85,913	2,545,793	91,850	3,005,856	103,257	3,940,069	121,062	4,548,573

Production of mineral paints, 1897-1904—Continued.

Kind.	1901.		1902. [d]		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
Ocher	16,711	$177,799	16,565	$145,708	12,524	$111,625	16,826	$110,602
Umber	759	11,326	480	11,230	666	15,367	522	12,960
Sienna	305	9,304	189	4,316				
Metallic paint	15,915	204,937	[e] 19,020	313,390	25,103	213,109	19,357	204,377
Mortar color	9,346	112,943	8,355	98,729	10,863	101,792	7,525	84,426
Venetian red	9,201	153,467	11,758	196,905	7,425	134,635	7,449	137,737
Zinc white	46,500	3,720,000	52,645	4,016,499	62,962	4,801,718	63,363	4,808,482
Soapstone	50	350	1,100	2,200	....	....	....	....
Slate [c]	4,865	41,211	[f] 4,071	39,401	7,106	59,029	5,370	53,709
Other colors	4,308	78,625	[g] 11,511	132,453	....	....	2,736	27,360
Total	107,960	4,509,962	125,694	4,960,831	126,649	5,437,275	123,148	5,439,653

[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.

From this table it is seen that there was a decided increase in the quantity of ocher produced during 1904, but a slight decrease in value; while with metallic paint there was a large decrease in the quantity, but only a comparatively slight decrease in the value. There were also decreases in the productions of umber and sienna, mortar colors, and slate, but increases in the productions of zinc white and venetian red. This table illustrates also the 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 mined. Thus, in 1904, although the tonnage of ocher was largely increased, there was a slight decrease in the value. This variation was due to the large quantity of low-grade ocher that was put on the market, which reduced the average value, although the market value of the ocher pigments were approximately the same in 1904 as in 1903.

OCHER, UMBER, AND SIENNA.

These three pigments are all obtained from ocherous iron ores, clays, and other earths containing a considerable percentage of iron oxide. Although there are large deposits of these materials throughout the United States that could be used for the manufacture of these pigments, still many of them, on account of their distance from railroad transportation facilities, are at the present time of little or no commercial value.

PRODUCTION.

The production of ocher in the United States during 1904 amounted to 16,826 short tons, valued at $110,602, an increase of 4,302 tons in quantity, but a decrease of $1,023 in value, as compared with the production of 1903 of 12,524 tons, valued at $111,625. Seven States and one Territory contributed to this output of ocher, which are given below in the order of the importance of their production, together with the number of producers in each: Georgia, 3; Pennsylvania, 5; Arkansas, 1; Indian Territory, 1; California, 3; Vermont, 4; Iowa, 2; Virginia, 1.

Of this 1904 output, Georgia produced 4,752 tons, valued at $44,142, or 28 per cent of the total output, and Pennsylvania 4,077 tons, valued at $29,355, or 24 per cent of the total output. The Georgia production was 460 tons in quantity and $3,766 in value less than the 1903 production of 5,212 short tons, valued at $47,908; and the Pennsylvania production was 860 tons in quantity and $5,427 in value less than the 1903 production of 4,937 short tons, valued at $34,782.

The production of umber was confined entirely to Pennsylvania and the production of sienna to Pennsylvania and New York. The combined productions of these two minerals during 1904 amounted to 522 short tons, valued at $12,960, as compared with 666 short tons, valued at $15,367 in 1903, a decrease of 144 tons in quantity and of $2,407 in value. There are shown in the following tables the production of ocher, by States, for the last five years, and the total production of ocher, umber, and sienna since 1896. The variations to be noted in the value of these mineral pigments are due to the different grades of the materials produced rather than to fluctuations in prices.

Production of ocher in 1900, 1901, 1902, 1903, and 1904, by States.

State.	1900.		1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*		*Short tons.*	
Georgia	6,828	$73,172	5,077	$49,176	3,688	$38,423	5,212	$47,908	4,752	$44,142
Pennsylvania	7,601	84,661	7,632	76,106	9,818	80,259	4,937	34,782	4,077	29,355
Vermont	401	3,856	370	3,493	441	4,544	(a)	(a)	2,176	5,200
California	....	....	....	....	580	3,650	(a)	(a)	412	4,750
Other States	2,185	25,018	3,632	49,024	2,038	18,832	b 2,375	b 28,935	c 5,409	c 27,155
Total	17,015	186,707	16,711	177,799	16,565	145,708	12,524	111,625	16,826	110,602

a Included in Other States.
b Including California, Iowa, Vermont, and Virginia.
c Including Arkansas, Iowa, Virginia, and Indian Territory.

Production of ocher, umber, and sienna, 1896–1904.

Year.	Ocher.		Umber.		Sienna.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
1896	14,074	$136,458	165	$2,646	395	$5,416	14,634	$144,520
1897	14,006	162,764	[a]1,080	11,710	620	10,610	15,706	185,084
1898	11,963	123,832	[b]1,177	8,285	689	11,140	13,829	143,257
1899	14,124	140,168	473	4,151	588	8,205	15,185	152,524
1900	17,015	186,707	1,452	26,927	957	14,771	19,424	228,405
1901	16,711	177,799	759	11,326	305	9,304	17,775	198,429
1902	16,565	145,708	480	11,230	189	4,316	17,234	161,254
1903	12,524	111,625	[c]666	15,367	....	....	13,190	126,992
1904	16,826	110,602	[c]522	12,960	....	....	17,348	123,562

[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	17,555	$237,523
1885	3,950	43,575	1891	18,294	233,823
1886	6,300	91,850	1892	14,365	193,074
1887	8,000	75,000	1893	11,147	141,828
1888	10,000	120,000	1894	10,193	104,015
1889	15,158	177,472	1895	12,640	150,628

IMPORTS.

The imports of ocher, umber, and sienna are nearly equal to the value of the domestic production, and in 1904 the total imports of these pigments amounted to 6,505 short tons, valued at $136,745, as compared with 6,952 tons, valued at $147,289, in 1903, this being a decrease of 447 tons in quantity and of $10,544 in value. Of the 1904 imports, 4,722 tons, valued at $93,720, was due to ocher, against 4,930 tons, valued at $100,447, in 1903; 1,137 tons, valued at $20,511, was due to umber, against 1,085 tons, valued at $18,272, in 1903; and 646 tons, valued at $22,514, was due to sienna, against 937 tons, valued at $28,570, in 1903. There are given in the following tables the quantity and value of ocher, umber, and sienna imported into the United States from 1867 to 1904, inclusive:

Ocher, etc., imported, 1867–1883.

Fiscal year ending June 30—	All ground in oil.		Indian red and Spanish brown.		Mineral French and Paris green.		Other, dry, not otherwise specified.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*		*Pounds.*		*Pounds.*	
1867	11,373	$385	....	$35,374	....	$2,083	1,430,118	$9,923
1868	6,949	333	....	11,165	....	500	3,670,093	32,102
1869	65,344	2,496	2,582,335	31,624	8,369	2,495	5,379,478	39,546
1870	149,240	6,042	3,377,944	41,607	9,618	3,444	3,935,978	32,593
1871	121,080	4,465	2,286,930	40,663	33,488	11,038	2,800,148	24,767
1872	277,617	9,225	2,810,282	38,763	41,422	10,341	5,645,343	56,680
1873	94,245	3,850	135,360	2,506	34,382	8,078	3,940,785	51,318
1874	98,176	4,623	263,389	3,772	102,876	18,153	3,212,988	35,365
1875	280,517	12,352	646,009	9,714	64,910	13,506	3,282,415	37,929
1876	63,916	3,365	2,524,989	19,555	21,222	5,385	3,962,646	47,405
1877	41,718	2,269	2,179,631	24,218	27,687	6,724	3,427,208	32,924
1878	25,674	1,591	2,314,028	23,677	67,655	14,376	3,910,947	33,260
1879	17,649	1,141	2,873,550	26,929	17,598	3,114	3,792,850	42,563
1880	91,293	4,233	3,655,920	32,726	16,154	3,269	4,602,546	52,120
1881	99,431	4,676	3,201,880	30,195	75,465	14,648	3,414,704	46,069
1882	159,281	7,915	3,789,586	34,136	18,293	2,821	5,530,204	68,106
1883	137,978	6,143	1,549,968	13,788	6,972	885	7,022,615	90,593

Imports of ocher of all kinds, 1884–1904.

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
December 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	45,571	31,460	1,546	5,930,185	47,117
1899	9,765,616	72,825	14,881	756	9,780,497	73,581
1900	8,449,252	57,341	19,167	1,019	8,468,419	58,360
1901	8,546,690	83,196	16,738	918	8,563,428	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	9,860,334	100,447
1904	9,430,916	93,137	12,756	583	9,443,672	93,720

[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, 1867–1904.

Year ending—	Quantity.	Value.	Year ending—	Quantity.	Value.
June 30—	*Pounds.*		December 31—	*Pounds.*	
1867	2,147,342	$15,946	1886	1,262,930	$9,187
1868	345,173	2,750	1887	2,385,281	16,536
1869	570,771	6,159	1888	1,423,800	14,684
1870	708,825	6,313	1889	1,555,070	20,887
1871	470,392	7,064	1890	1,556,823	19,329
1872	1,409,822	18,203	1891	633,291	6,498
1873	845,601	8,414	1892	1,028,038	6,256
1874	729,864	6,200	1893	1,488,849	16,636
1875	513,811	5,596	1894	632,995	6,275
1876	681,199	7,527	1895	[a] 1,560,786	13,075
1877	1,101,422	10,213	1896	[b] 689,075	8,360
1878	1,038,880	8,302	1897	[c] 1,447,889	14,479
1879	986,105	6,959	1898	[d] 1,023,079	9,051
1880	1,877,645	17,271	1899	[e] 1,739,036	13,326
1881	1,475,835	11,126	1900	[f] 1,703,256	11,862
1882	1,923,648	20,494	1901	[g] 1,565,431	12,510
1883	785,794	8,419	1902	[h] 1,899,425	16,133
1884	2,946,675	20,654	1903	[i] 2,169,570	18,272
1885	1,198,000	8,504	1904	[j] 2,274,926	20,511

[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 1,018,471 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 1,562,247 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 2,159,914 pounds "dry—crude and powdered, washed or pulverized."
[j] Includes 13,133 pounds "ground in oil" and 2,261,793 pounds "dry—crude and powdered, washed or pulverized."

Imports of sienna, 1893–1904.

Year ending Dec. 31—	Dry.		Ground in oil.		Year ending Dec. 31—	Dry.		Ground in oil.	
	Quantity.	Value.	Quantity.	Value.		Quantity.	Value.	Quantity.	Value.
	Pounds.		*Pounds.*			*Pounds.*		*Pounds.*	
1893	1,626,536	$138,889	5,857	$610	1899	798,691	$14,470	6,484	$492
1894	337,909	9,424	18,877	895	1900	796,534	14,912	6,335	495
1895	456,861	11,021	6,576	501	1901	1,106,553	18,394	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	504,713	11,451	4,008	280	1904	1,285,301	22,118	5,770	396

PRODUCTION OF OCHER IN PRINCIPAL PRODUCING COUNTRIES.

France is the largest producer of ocher, and its output usually amounts to more than the combined production of the United States and Great Britain, who usually rank second and third in the output of these pigments. In the following table is given the output of ocher in the principal producing countries of the world for the years 1893 to 1904, inclusive, as far as the statistics are available:

Production of ocher in principal producing countries, 1893–1904.

Year.	United States.		United Kingdom.		France.		German Empire.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
1893	11,147	$141,828	11,798	$67,318	....	....	....	....
1894	10,193	104,015	9,538	68,094	....	....	....	....
1895	12,640	150,628	8,540	82,397	36,456	$142,756	9,911	$25,297
1896	14,634	144,520	11,078	99,737	30,304	125,164	9,918	26,227
1897	15,706	185,084	16,153	63,165	35,594	150,714	9,660	25,242
1898	13,829	143,257	22,206	63,065	37,236	152,002	9,642	31,737
1899	14,124	140,168	18,272	66,082	36,090	155,821	10,234	31,750
1900	17,015	186,707	17,024	61,627	36,454	164,000	12,681	25,078
1901	16,711	177,799	16,287	69,585	39,357	275,930	77,047	102,385
1902	16,565	145,708	18,999	112,030	38,327	368,328	15,374	27,863
1903	12,524	111,625	15,848	82,839	37,524	652,811	21,535	53,672
1904	16,826	110,602	....	....	....	....	....	....

Year.	Canada.		Belgium.		Spain.		Cyprus.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
1893	1,070	$17,710	1,408	$1,351	1,135	$685	....	....
1894	611	8,690	400	965	132	232	1,714	$3,822
1895	1,339	14,600	800	1,930	224	760	1,500	3,293
1896	2,362	16,045	1,120	2,702	234	820	3,240	6,955
1897	3,905	23,560	560	1,400	220	772	1,721	3,776
1898	2,340	18,531	320	1,138	220	800	3,206	4,656
1899	3,919	19,900	330	1,158	110	400	1,098	2,443
1900	1,966	15,398	330	1,158	64	232	....	....
1901	2,233	16,735	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	220	800	....	....	[a] 3,506	7,499
1904	3,925	24,995	....	....	....	....	....	....

[a] Umber exports.

METALLIC PAINT.

PRODUCTION.

During 1904 the production of metallic paint was obtained from the following States, given in the order of the importance of their production, together with the number of producers in each: Pennsylvania, 6; New York, 4; Alabama, 1; Tennessee, 2; Wisconsin, 2; Ohio, 2; New Jersey, 1. Maryland and Virginia, which had a production in 1903, did not report any for 1904. The output amounted to 26,882 short tons, valued at $288,803, as compared with 35,966 tons, valued at $314,901, in 1903, a decrease of 9,084 tons in quantity and of $26,098 in value. Of the production in 1904, 19,357 short tons, valued at $204,377, was metallic paint, exclusive of mortar colors, as compared with 25,103 tons, valued at $213,109, in 1903—a decrease of 5,746 tons in quantity and of $8,732 in value. The production of mortar colors in 1904 was 7,525 short tons, valued at $84,426, as compared with 10,863 short tons, valued at $101,792, in 1903—a decrease of 3,338 tons in quantity and of $17,366 in value. In the following table are given the statistics of production of metallic paint and mortar colors during 1901 to 1904, inclusive, by States:

Production of metallic paint and mortar colors in 1901, 1902, 1903, and 1904, by States.

State.	1901.				1902.			
	Metallic paint.		Mortar colors.		Metallic paint.		Mortar colors.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*		*Short tons.*	
New York	2,065	$25,150	3,300	$45,000	1,400	$15,000	4,534	$49,400
Pennsylvania	8,422	120,298	2,150	22,400	9,981	233,832	925	10,600
Tennessee	3,100	27,350	1,500	15,000	5,150	40,880	969	12,990
Ohio								
Other States	2,328	31,939	2,396	30,543	[a] 2,489	23,678	1,927	25,739
Total	15,915	204,737	9,346	112,943	19,020	313,390	8,355	98,729

State.	1903.				1904.	
	Metallic paint.		Mortar colors.		Metallic paint and mortar colors.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
New York	4,660	$42,180	6,362	$53,619	4,550	$53,150
Pennsylvania	11,120	112,810	1,800	22,200	7,710	107,609
Tennessee					5,292	36,071
Ohio	771	12,020			1,750	21,300
Other States	8,552	46,099	2,701	25,973	[b] 7,580	70,673
Total	25,103	213,109	10,863	101,792	26,882	288,803

[a] Includes 800 tons of unground material, valued at $800.
[b] Alabama, New Jersey, and Wisconsin.

The following table shows the annual production of metallic paint and mortar colors from 1889 to 1904:

Production of metallic paint and mortar colors, 1889–1904.

Year.	Metallic paint.		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	10,863	101,792
1896	14,805	180,134	9,660	89,600	1904	19,357	204,377	7,525	84,426

[a] Includes mortar colors from 1889 to 1893, inclusive.

VENETIAN RED.

PRODUCTION.

The production of Venetian red in 1904 was 7,449 short tons, valued at $137,737, as compared with 7,425 short tons, valued at $134,635 in 1903, an increase of 24 tons in quantity and of $3,102 in value. The production of Venetian red in the United States since 1890 is shown in the following table:

Production of Venetian red, 1890–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1890	4,000	$84,100	1898	10,271	$160,711
1891	4,191	90,000	1899	11,991	210,361
1892	4,900	106,800	1900	14,696	236,574
1893	3,214	64,400	1901	9,201	153,467
1894	2,983	73,300	1902	11,758	196,905
1895	4,595	102,900	1903	7,425	134,635
1896	4,138	93,866	1904	7,449	137,737
1897	13,603	294,744			

SLATE AND SHALE.

PRODUCTION.

The total quantity of slate and shale that was ground for use as pigments in 1904, together with that reported under the name of mineral black, amounted to 5,370 short tons, valued at $53,709, a decrease of 1,736 tons in quantity and of $5,320 in value, as compared with the production of 7,106 short tons, valued at $59,029, in 1903. These values do not include the graphitic or carbonaceous shale or schist mined in Michigan and known as "Baraga graphite," which is used almost exclusively in the manufacture of graphite paints and which is included under the head of graphite.

The annual production of pigments made from slate and shale has been as follows:

Quantity and value of slate and shale ground for pigment, 1880–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	1,120	$10,000	1893	3,253	$25,567
1881	1,120	10,000	1894	3,300	35,370
1882	2,240	24,000	1895	4,331	45,682
1883	2,240	24,000	1896	4,795	44,835
1884	2,240	20,000	1897	4,666	46,681
1885	2,212	24,687	1898	4,571	46,215
1886	3,360	30,000	1899	4,676	43,703
1887	2,240	20,000	1900 [a]	6,395	53,942
1888	2,800	25,100	1901	4,865	41,211
1889	2,240	20,000	1902	4,071	39,401
1890	2,240	20,000	1903	7,106	59,029
1891	2,240	20,000	1904 [a]	5,370	53,709
1892	3,787	23,523			

[a] Includes mineral and carbon black.

ZINC WHITE.

PRODUCTION.

The production of zinc white has been increasing steadily since 1896, and in 1904 the production amounted to 63,363 short tons, valued at $4,808,482, an increase of 401 tons in quantity and of $6,764 in value as compared with 62,962 short tons, valued at $4,801,718, in 1903.

The following table gives the quantity and value of zinc white produced in the United States from 1880 to 1904, inclusive, and illustrates the continual growth of the use of this material as a white pigment:

Production of zinc white, 1880–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	10,107	$763,738	1893	24,059	$1,804,420
1881	10,000	700,000	1894	19,987	1,399,090
1882	10,000	700,000	1895	20,710	1,449,700
1883	12,000	840,000	1896	20,000	1,400,000
1884	13,000	910,000	1897	25,000	1,750,000
1885	15,000	1,050,000	1898	33,000	2,310,000
1886	18,000	1,440,000	1899	40,146	3,211,680
1887	18,000	1,440,000	1900	48,840	3,667,210
1888	20,000	1,600,000	1901	46,500	3,720,000
1889	16,970	1,357,600	1902	52,730	4,023,299
1890	....	1,600,000	1903	62,962	4,801,718
1891	23,700	1,600,000	1904	63,363	4,808,482
1892	27,500	2,200,000			

IMPORTS.

Notwithstanding the continuous growth of the zinc-white industry in the United States, there is a considerable amount of this oxide imported each year into this country, but it represents but a small percentage of the total consumption. During 1904 the imports of zinc oxide were: Dry, 2,585,661 pounds; in oil, 224,244 pounds, making a total of 2,809,905 pounds, as compared with the importation in 1903 of 3,487,042 pounds of dry and 166,034 pounds in oil, a total of 3,653,076, this being a decrease for 1904 of 843,171 pounds. The total value of the imports of zinc oxide for 1904 was $165,110, as compared with $188,494 in 1903. 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), 1885–1904.

Year ending—	Dry.	In oil.	Year ending—	Dry.	In oil.	Total value.
	Pounds.	*Pounds.*	December 31—	*Pounds.*	*Pounds.*	
June 30, 1885	2,233,128	98,566	1894	3,371,292	59,291	$122,690
December 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	38,926	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
			1904	2,585,661	224,244	165,110

LEAD PAINTS.

WHITE LEAD, SUBLIMED 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 products of metallic lead, from which they are manufactured, but their value is excluded from this tabulation in order to avoid duplication. There are included under the lead paints the following: White lead, sublimed lead, zinc lead, red lead, litharge, and orange mineral.

PRODUCTION.

The total production of all lead pigments during 1904 amounted to 155,716 short tons, valued at $17,002,212, an increase of 13,230 tons in quantity and of $1,290,617 in value, as compared with 142,486 short tons, valued at $15,711,595, the production of 1903. The imports of these lead pigments in 1904 amounted to 1,117 short tons, valued at

$102,581, as compared with 1,203 short tons, valued at $103,312, in 1903. This makes the total quantity of lead pigments consumed in the United States during 1904 equal to 148,197 short tons, valued at $16,083,702, as against 143,689 short tons, valued at $15,814,907, in 1903, a total gain for 1904 of 4,508 tons in quantity and of $268,795 in value.

WHITE LEAD.

PRODUCTION.

The total production of white lead in the United States during 1904 is estimated at 123,346 short tons, valued at $13,756,929. As compared with the production of 113,886 short tons, valued at $12,837,647, in 1903, this is an increase of 9,460 tons in quantity and of $919,282 in value. Of the 1904 production, the quantity reported of white lead in oil was 58,332 short tons, valued at $6,935,620, and the quantity reported of dry white lead and white oxide was 65,014 short tons, valued at $6,821,309. The quantity of white lead imported during 1904 was only 294 short tons, valued at $33,788, as compared with 227 short tons, valued at $24,595, in 1903. Thus the imports of white lead are an extremely small percentage of the total quantity of white lead consumed in the United States.

The annual production of white lead since 1894 has been as follows:

Production of white lead in the United States, 1884–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1884	65,000	$6,500,000	1895	90,513	$8,723,632
1885	60,000	6,300,000	1896	88,608	8,371,588
1886	60,000	7,200,000	1897	95,658	9,676,815
1887	70,000	7,560,000	1898	96,047	9,400,622
1888	84,000	10,080,000	1899	110,197	11,317,957
1889	80,000	9,600,000	1900	98,210	10,657,956
1890	77,636	9,382,967	1901	100,787	11,252,653
1891	78,018	10,454,029	1902	114,658	11,978,174
1892	74,485	8,733,620	1903	113,886	12,837,647
1893	72,172	7,695,130	1904	123,346	13,756,929
1894	76,343	6,623,071			

PRICES.

In the table following are shown the average yearly market prices of corroded pig lead and 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, 1874–1904.

[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	1890	$4.33	$6.25	$1.92
1875	5.95	10.50	4.55	1891	4.33	6.37	2.05
1876	6.05	10.00	3.95	1892	4.05	6.39	2.34
1877	5.43	9.00	3.57	1893	3.73	6.03	2.30
1878	3.58	7.25	3.67	1894	3.28	5.26	1.98
1879	4.18	7.00	2.82	1895	3.28	5.05	1.77
1880	5.05	7.60	2.55	1896	3.03	4.90	1.87
1881	4.80	7.25	2.45	1897	3.64	5.00	1.36
1882	4.90	7.00	2.10	1898	3.79	5.08	1.29
1883	4.32	6.88	2.56	1899	4.53	5.35	.82
1884	3.73	5.90	2.17	1900	4.55	5.57	1.02
1885	3.95	6.00	2.05	1901	4.51	5.87	1.36
1886	4.63	6.25	1.62	1902	4.21⅗	5.62	1.40⅖
1887	4.47	5.75	1.28	1903	4.23	6.39	2.16
1888	4.41	5.75	1.34	1904	....	....	....
1889	3.80	6.00	2.20				

SUBLIMED LEAD.

The product that is obtained in the oxidized smelting of galena ores is known as sublimed lead, and consists essentially of lead sulphates and lead oxide. This product is produced by the Picher Lead Company, of Joplin, Mo., and in 1904 the production amounted to 12,954,000 pounds, valued at $550,587, an increase over 1903 of 4,362,000 pounds in quantity and of $163,947 in value. In the following table is shown the quantity and value of the sublimed lead manufactured since 1902, when this company first began to put this material on the market:

Production of sublimed lead in the United States, 1902–1904.

Year.	Quantity.	Value.
	Pounds.	
1902	9,465,500	$449,611
1903	8,592,000	386,640
1904	12,954,000	550,587

ZINC LEAD.

A pigment, composed principally of lead and zinc oxides, obtained by an oxidizing-smelting treatment of lead and zinc ores in a furnace of special design, is manufactured by the United States Production and Refining Company, of Canyon, Cal., and is put on the market under the name of zinc lead. Since the company first began to make this material, in 1901, there has been a very decided increase in its production and use as a pigment. In 1904 the production amounted to 5,779 short tons, valued at $404,530, an increase of 1,279 tons in quantity and of $157,030 in value, as compared with 4,500 short tons, valued at $247,500, the production of 1903.

In the following table is given the quantity and value of zinc lead since 1901, the year it was first produced for market:

Production of zinc lead in United States, 1901–1904.

Year.	Quantity.	Value.
	Short tons.	
1901	2,500	$150,000
1902	4,000	225,000
1903	4,500	247,500
1904	5,779	404,530

RED LEAD, LITHARGE, AND ORANGE MINERAL.

PRODUCTION.

There was a very large increase in the production of red lead in 1904, which amounted to 10,271 short tons in quantity and $1,206,073 in value, as compared with the production of 8,832 short tons, valued at $1,022,754, in 1903, an increase of 1,439 tons in quantity and of $183,319 in value. The combined production of litharge and orange mineral during 1904 was 9,839 short tons, valued at $1,084,093, as compared with 10,972 short tons, valued at $1,217,054, in 1903, a decrease of 1,133 tons in quantity and of $132,961 in value. There is still a considerable quantity of litharge, orange mineral, and red lead imported into the United States, and in 1904 the imports of these pigments were as follows: Of litharge 44,541 pounds, valued at $1,500; of orange mineral, 766,469 pounds, valued at $37,178, and of red lead 836,077 pounds, valued at $30,115; as compared with the imports of these pigments in 1903, 42,756 pounds of litharge, valued at $1,464; 756,742 pounds of orange mineral, valued at $36,407, and 1,152,715 pounds of red lead, valued at $40,846, there was a slight increase in the importation of litharge and orange mineral, but a decrease in the quantity of red lead.

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 to 1904, inclusive:

Production of white lead, sublimed lead, zinc lead, red lead, litharge, and orange mineral during 1901, 1902, 1903, and 1904.

	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
White lead:	*Pounds.*		*Pounds.*		*Pounds.*		*Pounds.*	
In oil	154,606,670	$8,978,441	179,473,588	$9,755,197	125,348,000	$7,482,487	116,664,563	$6,935,620
Dry [a]	46,966,945	2,274,212	49,841,821	2,222,977	102,424,000	5,355,160	130,027,460	6,821,309
Sublimed lead	....	....	9,465,500	449,611	8,592,000	386,640	12,951,000	550,587
Zinc lead	5,000,000	150,000	8,000,000	225,000	9,000,000	247,500	11,558,000	404,530
Red lead	26,206,096	1,448,550	23,338,252	1,263,112	17,664,000	1,022,754	20,541,190	1,206,073
Litharge	18,919,036	979,586	25,510,690	1,298,343	20,642,000	1,116,361	19,677,345	1,084,093
Orange mineral	2,174,727	224,667	1,973,521	139,349	1,302,000	100,693		

[a] Including white oxide.

IMPORTS.

The table below gives the quantity and value of the imports of white lead, red lead, litharge, and orange mineral from 1867 to 1904, inclusive:

White lead, red lead, litharge, and orange mineral imported, 1867–1904.

Year ending—	White lead.		Red lead.		Litharge.		Orange mineral.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
June 30—	*Pounds.*		*Pounds.*		*Pounds.*		*Pounds.*	
1867	6,636,508	$430,805	926,843	$53,087	230,382	$8,941	....	....
1868	7,533,225	455,698	1,201,144	76,773	250,615	12,225	....	....
1869	8,948,642	515,783	808,686	46,481	187,333	7,767	....	....
1870	6,228,285	365,706	1,042,813	54,626	97,398	4,442	....	....
1871	8,337,842	483,392	1,295,616	78,410	70,889	3,870	....	....
1872	7,153,978	431,477	1,513,794	85,644	66,544	3,396	....	....
1873	6,331,373	408,986	1,583,039	99,891	40,799	2,379	....	....
1874	4,771,509	323,926	756,644	56,305	25,687	1,450	....	....
1875	4,354,131	295,642	1,048,713	73,131	15,767	950	....	....
1876	2,546,776	175,776	749,918	54,884	47,054	2,562	....	....
1877	2,644,184	174,844	387,260	28,747	40,331	2,347	....	....
1878	1,759,608	113,638	170,608	9,364	28,190	1,499	....	....
1879	1,274,196	76,061	143,237	7,237	38,495	1,667	....	....
1880	1,906,931	107,104	217,033	10,397	27,389	1,222	....	....
1881	1,068,030	60,132	212,423	10,009	63,058	2,568	....	....
1882	1,161,889	64,493	288,946	12,207	54,592	2,191	....	....
1883	1,044,478	58,588	249,145	10,503	34,850	1,312	....	....
1884	902,281	67,918	265,693	10,589	54,183	1,797	....	....
1885	705,535	40,437	216,449	7,641	35,283	1,091	....	....
December 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	....	....

White lead, red lead, litharge, and orange mineral imported, 1867–1904—Continued.

Year ending—	White lead.		Red lead.		Litharge.		Orange mineral.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
December 31—	*Pounds.*		*Pounds.*		*Pounds.*		*Pounds.*	
1890	742,196	$57,659	450,402	$20,718	48,283	$2,146	....	....
1891	718,228	40,773	651,577	23,807	94,586	3,108	....	....
1892	744,838	40,032	812,703	28,443	56,737	1,811	1,409,601	$64,133
1893	686,490	34,145	854,982	27,349	42,582	1,310	1,385,828	61,360
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	384,671	21,226	485,466	19,369	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
1904	587,338	33,788	836,077	30,115	44,541	1,500	766,469	37,178

FULLER'S EARTH.[a]

INTRODUCTION.

The characteristics of fuller's earth are its variegated color—greenish-white, gray, brown, olive, or olive-green—soft texture, and greasy feel. In appearance it resembles clay, and when placed in water will fall into powder, but does not become plastic.

The composition of fuller's earth varies greatly, chemical analyses of the commercial grades showing a content of 50 to 63 per cent silica, about 10 per cent alumina, from 5 to 10 per cent water, and a fluctuating percentage of iron, calcium, magnesium, and other impurities. Different localities will produce mineral of varying composition, and not infrequently analyses made in the same vicinity will show a wide range in the percentage of silica and moisture. To decide what quality of fuller's earth is better adapted to a certain industrial use, it is necessary to submit to actual trial, in which case the chemical analysis will be of some service.

Abroad the principal use of fuller's earth is for fulling wool, but in America the greater demand is for deodorizing, bleaching, and clarifying fats, oils, and greases. In this country the largest consumers are the manufacturers of lard and cottolene. For the purpose of clarifying lard and cotton-seed oil a small quantity, 2 to 3 per cent, of fuller's earth is ground to a fineness of 100 to 120 mesh and is added to the hot oil. After a thorough agitation the hot liquid is passed through a filter press, and when the earth and coloring impurities have been removed the oil is nearly white. It is understood that fuller's earth has almost superseded bone black in this process. A small quantity of fuller's earth is also marketed in powdered form, specially prepared, for removing grease spots from paper, etc. It might also be used to advantage in removing calcium carbonate from water for boiler supply, thus preventing deleterious incrustations.

PRODUCTION.

The total production of fuller's earth increased from 20,693 short tons, valued at $190,277, in 1903, to 29,480 short tons, valued at $168,500, in 1904. The price, it is to be noted, was considerably less during 1904 than in 1903. The production was limited largely to Florida, shared to some extent by Arkansas, and to a less degree by Alabama,

[a] Credit for the report on fuller's earth should be given to Dr. Chas. C. Schnatterbeck.—D. T. D.

Massachusetts, Colorado, and New York; and Utah produced an experimental lot of half a ton during the year. The demand and uses for fuller's earth have not changed radically during the period under review. The value of fuller's earth as a bleacher in the filtration treatment of various oils is shown in that, while the quantity produced in the United States increased from about 7,000 short tons in 1895 to about 30,000 tons in 1904, the imports have grown also from over 8,000 tons in 1898 to over 15,000 tons in 1903. These 15,000 tons, together with our production of that year, made a total consumption of over 35,000 tons for 1903, and similarly in 1904, in spite of the increased production to 29,480 short tons, the importations also amounted to over 9,000 tons, making nearly 40,000 short tons as the total quantity which the industry absorbed. The importations of fuller's earth for years earlier than 1897 were comparatively small.

The production of Florida in 1904 was about three-fourths of the output of the United States, and it will probably be increased next year; it is probable, also, that the output of Arkansas for use in refining animal and cotton-seed oils will be considerably increased.

The following table gives the production of fuller's earth from 1895 to 1904, inclusive:

Production of fuller's earth in the United States, 1895–1904.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1895	6,900	$41,400	1900	9,698	$67,535
1896	9,872	59,360	1901	14,112	96,835
1897	17,113	112,272	1902	11,492	98,144
1898	14,860	106,500	1903	20,693	190,277
1899	12,381	79,644	1904	29,480	168,500

IMPORTS.

The quantity and value of the fuller's earth imported into the United States from 1897 to 1904, inclusive, are shown in the following table:

Fuller's earth imported into the United States, 1897–1904.

[Long tons.]

Class.	1897.[a]		1898.		1899.		1900.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Unwrought or unmanufactured	2,308	$14,283	2,038	$15,921	3,743	$23,194	2,431	$14,750
Wrought or manufactured	2,138	20,037	6,315	55,123	6,577	46,446	5,742	50,047
Total	4,446	34,320	8,353	71,044	10,320	69,640	8,173	64,797

[a] July to December, only.

Fuller's earth imported into the United States, 1897–1904—Continued.

[Long tons.]

Class.	1901.		1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Unwrought or unmanufactured	2,916	$17,230	3,785	$26,635	3,804	$28,339	1,763	$9,546
Wrought or manufactured	7,850	63,467	9,728	75,945	11,464	92,332	7,363	64,460
Total	10,766	80,697	13,513	102,580	15,268	120,671	9,126	74,006

In the following table is shown the quantity and value of the fuller's earth imported from 1867 to 1883, by fiscal years. The wrought and the unwrought earths were not classified separately during this period. From July 1, 1883, to June 30, 1897, fuller's earth was not reported separately in the custom-house returns to the Treasury Department, but was included with other minerals "not elsewhere specified."

Imports of fuller's earth, 1867–1883.

[Long tons.]

Year ending June 30—	Quantity.	Value.	Year ending June 30—	Quantity.	Value.
1867	280	$3,113	1876	246	$3,097
1868	211	2,522	1877	400	4,460
1869	324	3,587	1878	335	4,095
1870	239	2,619	1879	361	4,269
1871	290	3,383	1880	578	6,925
1872	274	3,358	1881	268	3,207
1873	251	2,978	1882	908	11,444
1874	277	3,440	1883	1,241	14,309
1875	300	3,694			

ASBESTOS.

By Joseph Hyde Pratt.

INTRODUCTION.

The principal changes to be noted in the asbestos industry at the close of 1904 are the increase in the production in the United States of the amphibole variety, the development of the Grand Canyon chrysotile asbestos deposits, and the increase in the demand for the chrysotile variety. The many new uses which have been devised for chrysotile asbestos have created a demand for it that is now in excess of the supply. Hence, any new localities containing this variety of asbestos are worthy of investigation in order to prove conclusively whether they do or do not contain commercial quantities. The high price which can be obtained for the chrysotile asbestos, when it is in fibers of sufficient length for spinning, permits of the mining of this mineral in some places where the cost of mining would become prohibitory with any material decrease in price.

No new occurrences of asbestos were developed during 1904, but all the old deposits which were referred to in the report of 1903 have been worked to some extent during the past year, although but few of them have been producers.

USES.

In the report for 1903 the uses of asbestos were taken up in detail; but in view of the interest felt in asbestos products, and especially in those relating to building materials, it is thought desirable to give here the results of certain experiments that have been made on asbestos building board by Mr. George F. Sever, of New York City. The tests were made for the Keasbey & Mattison Company, of New York City, and the following list of tests were made on asbestos building lumber and magnesia building lumber one-eighth, one-fourth, and one-half inch in thickness, respectively.

Test No. 1, in regard to electrical resistance, indicates that simply as an insulating material the magnesia board of either thickness is more satisfactory than the asbestos. In the following table are given the results of the tests on both the asbestos and the magnesia boards as regards their electrical resistance:

Tests showing electrical resistance of asbestos and magnesia building board, respectively.

[Voltmeter resistance, 71,500 ohms.]

ASBESTOS.

Specimen number.	Average thickness.	Test, E. M. F.	Deflection of voltmeter due to insulation resistance.	Insulation resistance.	Insulation resistance per inch of thickness.
	Inches.	*Volts.*		*Megohms.*	*Megohms.*
1	0.2770	550 555	91 95	0.3460	1.250
2	.2675	552	103	.3105	1.161
3	.2818	550	108	.2920	1.038
4	.2760	550	256	.0821	.2975
5	.2760	550	140	.2092	.757
6	.2782	550	174	.1545	.556
7	.2717	550	310	.0554	.204
8	.2755	549	232	.09775	.355
9	.1548	547	178	.1480	.970
10	.1464	550	175	.1532	1.048
11	.1576	554	108	.2955	1.870
12	.1508	549	94	.3460	2.295
13	.1558	550	115	.2700	1.735
14	.1493	550	175	.1520	1.020
15	.1558	550	212	.1143	.735
16	.1476	550	160	.1740	1.180
17	.5185	547	53	.6660	1.285
18	.5237	548	60	.5810	1.110
19	.5207	546	80	.4170	.816
20	.5240	546	85	.3880	.740
21	.5200	547	70	.4870	.936
22	.5190	549	45	.8000	1.541
23	.5260	550	76	.4450	.847
24	.5270	546	60	.5790	1.100
MAGNESIA.					
25	0.4940	550	22	1.7300	3.510
26	.4855	550	37	.9900	2.019
27	.4972	546	33	1.1100	2.237
28	.5000	547	37	.9850	1.970
29	.5015	546	38	.9560	1.910
30	.5010	546	39	.9300	1.860
31	.5000	546	35	1.0430	2.085
32	.4950	550	38	.9620	1.944
33	.2560	550	115	.2710	1.055
34	.2650	550	37	.9650	3.640
35	.2660	548	33	1.1130	4.180
36	.2555	550	112	.2800	1.097
37	.2550	547	110	.2840	1.130
38	.2620	540	40	.8950	3.420
39	.2520	547	40	.9070	3.600
40	.2625	556	45	.8130	3.100
41	.1130	555	25	1.5150	1.335
42	.1120	555	38	.9750	8.700
43	.1140	555	72	.4800	4.210
44	.1130	554	51	.5530	4.900
45	.1130	555	45	.8100	7.180
46	.1130	553	45	.8070	7.150
47	.1120	551	70	.4920	4.390
48	.1130	551	60	.5860	5.200

Test No. 2, relating to breakdown voltage, shows the magnesia board to be a better insulating material than the asbestos. One-half of the tests were made of material dried for five hours at 150° F., and the other set of experiments was upon material which had not been dried. In the table that follows are given the breakdown voltage for both the dried and the undried specimens.

Tests showing breakdown voltage of dried and undried asbestos and magnesia building board, respectively.

SPECIMENS DRIED FIVE HOURS AT 150° F.

Specimen number.	Material.	Average thickness.	Breakdown voltage.	
			Actual.	Per inch of thickness.
		Inches.		
1	Asbestos	0.2770	3,100	11,200
2	do	.2675	2,000	7,480
3	do	.2818	2,000	7,100
4	do	.2760	1,900	6,890
9	do	.1548	2,000	12,910
10	do	.1464	1,700	11,620
11	do	.1576	2,100	15,320
12	do	.1508	3,200	21,210
17	do	.5185	4,300	8,300
18	do	.5237	3,800	7,260
19	do	.5207	4,100	7,390
20	do	.5240	3,800	7,260
25	Magnesia	.4940	4,800	9,910
26	do	.4855	6,000	12,350
27	do	.4972	5,000	10,050
28	do	.5000	4,600	9,210
37	do	.2550	3,000	11,780
38	do	.2620	3,600	13,750
39	do	.2520	3,100	12,300
40	do	.2625	3,100	11,800
45	do	.1130	2,900	25,700
46	do	.1130	3,400	30,100
47	do	.1120	3,100	27,700
48	do	.1130	3,300	29,200

SPECIMENS NOT DRIED.

5	Asbestos	0.2760	1,100	3,990
6	do	.2782	1,100	3,955
7	do	.2717	1,000	3,700
8	do	.2755	1,100	4,000
13	do	.1558	1,200	7,700
14	do	.1493	1,900	12,720
15	do	.1558	1,000	6,420
16	do	.1476	1,200	8,130
21	do	.5200	2,700	5,200
22	do	.5190	2,800	5,400
23	do	.5260	2,700	5,140
24	do	.5270	2,600	4,940
29	Magnesia	.5015	2,700	5,390

Tests showing breakdown voltage of dried and undried asbestos and magnesia building board, respectively—Continued.

SPECIMENS NOT DRIED—Continued.

Specimen number.	Material.	Average thickness.	Breakdown voltage.	
			Actual.	Per inch of thickness.
		Inches.		
30	Magnesia	0.5010	2,700	5,390
31	....do	.5000	2,400	4,800
32	....do	.4950	2,700	5,450
33	....do	.2560	1,600	7,040
34	....do	.2650	1,800	6,800
35	....do	.2660	1,800	6,775
36	....do	.2555	1,600	6,275
41	....do	.1130	1,800	15,920
42	....do	.1120	1,800	16,080
43	....do	.1140	1,600	14,040
44	....do	.1130	1,600	14,180

Test No. 3, or arc test, in which the specimens were subjected to the heat of an arc lamp for a period of twenty seconds, the power at the arc being 500 watts, shows that asbestos board is a better fire or arc resistant than magnesia board. The surface of both the asbestos and the magnesia boards, after the completion of the test, gave indications that the strength of the fibrous material had been destroyed and that the portion to which the arc had been applied was brittle and easily broken.

Test No. 4 was in regard to the heat conductivity of these building boards. The specimens were held one-half inch away from the center of the seven-sixteenths-inch upright carbons of an arc lamp, and on the side of the material away from the arc there was pasted a thin white tissue paper, the charring point of which was found to be very definite and readily observable. This test shows that asbestos board is a very much better nonconductor of heat than magnesia board. The following table gives the results of these tests for both asbestos and magnesia boards:

Tests showing heat conductivity of dried and undried asbestos and magnesia building board, respectively.

ARC, 10 AMPERES AT 50 VOLTS.

Specimen number.	Material.	Average thickness.	Time to char paper.	Time to char paper per inch of thickness.	Remarks.
		Inches.	*Seconds.*	*Seconds.*	
1	Asbestos	0.2770	90	325	Specimens dried 10 hours at 150° F.
3	do	.2818	95	337	Do.
9	do	.1548	38	246	Do.
11	do	.1576	32	203	Do.
17	do	.5185	390	752	Do.
19	do	.5207	390	750	Do.
25	Magnesia	.4940	330	668	Do.
27	do	.4972	270	544	Do.
37	do	.2550	60	235.5	Do.
39	do	.2520	80	318	Do.
45	do	.1130	17	150.5	Do.
47	do	.1120	18	161	Do.
5	Asbestos	.2760	100	362	Specimens not dried.
7	do	.2717	100	369	Do.
13	do	.1558	40	257	Do.
15	do	.1558	40	257	Do.
21	do	.5200	420	808	Do.
23	do	.5260	435	828	Do.
29	Magnesia	.5015	300	600	Do.
31	do	.5000	330	660	Do.
33	do	.2560	85	332	Do.
35	do	.2660	90	338	Do.
41	do	.1130	20	179	Do.
43	do	.1140	17	149	Do.

Test No. 5 was for vibratory strength. Vibratory tests were made by nailing specimens of asbestos and magnesia board firmly to a wooden base and then noting the effect of blows from a 2-pound hammer, delivered at the rate of 70 per minute on the mass of the material, and also the effect of the vibration upon the holding power of the nails, the experiment lasting thirty minutes. The results showed that asbestos lumber withstands heavy blows and hard usage better than magnesia lumber. The results of these vibratory tests are given in the following table:

Vibratory tests on asbestos and magnesia lumber, respectively.

Specimen number.	Material.	Average thickness.	Effect of blows.
		Inches.	
1	Asbestos	0.2770	Slight indentation only; did not loosen about nails.
3	do	.2818	Do.
9	do	.1548	Slight indentation only; loosened slightly about holes.
11	do	.1576	Do.

Vibratory tests on asbestos and magnesia lumber, respectively—Continued.

Specimen number.	Material.	Average thickness.	Effect of blows.
		Inches.	
17	Asbestos	0.5185	No effect.
19	do	.5207	Do.
37	Magnesia	.2550	One-sixteenth of an inch indentation; material shows signs of splitting.
39	do	.2520	One thirty-second of an inch indentation; material shows signs of splittfng.
45	do	.1130	One thirty-second of an inch indentation; loose about nails.
47	do	.1120	Do.
25	do	.4940	Three thirty-seconds of an inch indentation; decided tendency to split shown on edge of sample.
27	do	.4972	One-sixteenth of an inch indentation; material split on edge.

In test No. 6 the absorbent characteristics of these two materials were determined by first thoroughly drying the specimens and then soaking them in water, first for four hours and finally for forty-eight hours. The results indicated that magnesia will absorb a considerably larger percentage of moisture than asbestos, and also that a part of the magnesia compound goes into solution, and thus it would appear that the asbestos board is better adapted for use in those places where moisture is liable to be present. Although the asbestos board was not absolutely moisture proof, still the percentage of moisture absorbed was small and did not have any deteriorating effect upon the asbestos board.

Test No. 7. Another test was made as to the ease with which these boards could be sawed and nailed, which showed that the magnesia board could be more readily worked with tools than the asbestos and could be more easily nailed, but that it was more liable to split. There is little or no tendency in the asbestos board to split, and it does not indent or break easily. Magnesia lumber is liable to split if subjected to a series of blows or if a sudden shock occurs too near the edge of the board.

The conclusion that Professor Sever reached, after making these experiments, is that the asbestos lumber possesses better mechanical properties than the magnesia, but that the magnesia is a better electrical insulator than the asbestos. The latter, however, stands better as a heat resisting and arc resisting medium than the magnesia, and thus from the standpoint of protection against fire hazard, asbestos board appears to possess more merit than magnesia board.

Other tests were made upon asbestos mill boards, respectively, one-eighth, one-fourth, and one-half inch in thickness, by Mr. Ira H. Woolson in the Mechanical Engineering Testing Laboratory of Columbia University. One test was by heating the samples first at a low temperature and then gradually raising the temperature until the samples came to a bright red heat. Another test was by placing samples of the asbestos board over a furnace with the temperature maintained at 1,700° F., and leaving them for various lengths of time. Still other samples were heated red hot and then plunged under a strong stream of cold water. The results of these tests on the three thicknesses of board were practically the same, with the exception that the thicker the specimens the longer the time it required to attain the same degree of heat. In all cases the material contracted on the side next to the fire, which caused it to warp or curve with the concave side next to the heat. This curving was quite marked and sometimes amounted to as much as half an inch in the specimens of the one-eighth-inch board, and the deformation was permanent, practically none of it being removed by cooling. This curvature was not half as much in the quarter-inch board, and in the half-inch board it was only about one-fifth of what it was in the one-eighth-inch board. These experiments show, as it had been demonstrated before, that a high degree of heat will cause the asbestos fibers to become brittle, although it does not destroy their heat-resisting properties.

This brittleness produced in the chrysotile asbestos has not unlikely been caused by the change in the molecular structure of the asbestos due to loss of water. Chrysotile asbestos is chemically a hydrous magnesium silicate represented by the formula $H_4Mg_3Si_2O_9$, or $2H_2O.3MgO.2SiO_2$. At a high temperature the two parts of water (H_2O) that the chrysotile asbestos contains would be readily driven off, leaving a compound composed of magnesia and silica. This change in the chemical composition of the material would change to some extent at least its physical character, and it is probable that it is the direct cause of the lost of strength of the fibers. The subjecting of the red-hot asbestos board to cold water did not seem to have any special effect, as it did not cause the board thus cooled to crack or become more brittle than one which had been cooled slowly.

The various asbestos boards on the market are similar in their construction and composition to those manufactured by the Keasbey & Mattison Company, at Ambler, Pa. These are stated to be composed of 25 per cent asbestos and 75 per cent Portland cement, which are thoroughly mixed together and submitted in sheets to a pressure of about 83 tons per square foot. The magnesia board or sheating is prepared by permeating the asbestos mill board with a solution of silicate of soda and bicarbonate of magnesia, the water being removed by subjecting the mill board to pressure.

Some interesting tests were made upon samples of the asbestos and magnesia sheathing of the Keasbey & Mattison Company at the Underwriters' Laboratories of Chicago, under the direction of the National Board of Fire Underwriters. The samples submitted for test were 24 by 36 inches in size, the two asbestos samples being respectively five-sixteenths and fifteen-thirty seconds of an inch thick, and the magnesia samples being respectively one-fourth and nine-sixteenths of an inch thick. The samples were mounted upon backings of seven-eighths inch undressed white pine not matched, the boards being separated about one-eighth of an inch at the joints in order that the observations might be made of the heat-conducting properties of the sheathing. In making the tests a brick furnace was used whose interior dimensions were 32 inches in height, 32 inches in width, and 18 inches in depth, with walls 6 inches thick. The roof of the furnace was of corrugated iron covered with sand and asbestos board. In the center of the front wall or side of the furnace there was a square opening 12 by 12 inches, which was covered by a quarter of an inch iron plate 24 by 24 inches, built vertically into the wall and lapping 6 inches on all sides of the opening. The heat was obtained by means of a $2\frac{1}{2}$-inch Bunsen burner supplied with natural gas at $2\frac{1}{2}$-inch pressure, the burner being set horizontally in the rear wall so that its flame fed directly upon the plate. In operating the furnace, the fire was started and maintained for twenty-five minutes before beginning the actual tests. The samples were then placed one at a time in an upright position before the heated plate, the surface being 6 inches from the plate. The results obtained by subjecting the five-sixteenths asbestos sheathing or board were as follows:

Five tests of $\frac{5}{16}$-inch asbestos sheathing, Chicago, 1904.

Time of exposure.	Results.	Time of exposure.	Results.
Minutes.		*Minutes.*	
0	Sample placed in position.	28	Buckling of sheathing slightly increased.
2	Very slight buckling of sheathing.	40	Sheathing shows very slight red color from rear side away from furnace.
$3\frac{1}{4}$	Escape of vapor.	$44\frac{1}{2}$	Backing ignites.
4	Sharp cracking sounds, but no appearance of cracks in surface.	45	Sample removed, and 3 gallons of cold water dashed immediately upon surface of same.
10	Distillation of gas from wood backing.		
12	Charring of wood noticed at joints between boards of backing.		
18	Slow charring of wood continues.		
24	Charring of wood increases, the charred portions at joints showing red color in spots; no flame.		

This sheet of asbestos sheathing was found to be considerably cracked by the application of the water, but did not appear to be disintegrated by the heat, and the surface remained hard and smooth. There was no scaling from the surface detected, the cracks extending through the sheet and the warping were very slight. The pine backing was charred to a depth of one-half inch back of the hottest area.

The asbestos sheathing fifteen thirty-seconds of an inch in thickness was subjected to a similar test with the following results:

Fire test of $\frac{15}{32}$-inch asbestos sheathing, Chicago, 1904.

Time of exposure.	Results.	Time of exposure.	Results.
Minutes.		*Minutes.*	
0	Sample placed in position.	19	Charring continues with considerable smoke; charred wood begins to show red color.
3	Slight buckling of sheathing.	45	Sample removed, no flame having occurred, and 3 gallons of cold water immediately dashed upon the surface of the same.
4	Escape of vapor.		
10	Distillation of gas from wood backing.		
16	Charring of wood backing begins.		

The surface of this sheathing appeared to be slightly disintegrated at the hottest portion, but the sheet was not cracked by application of water nor did it warp after cooling. The wood was charred to a depth of about three-eighths of an inch back of the exposed area.

From these experiments it would appear that, although these asbestos sheathings or boards are noncombustible, they have fairly good heat-conducting properties when their surfaces are subjected to intense heat. In the experiments described this is due probably, to some extent at least, to the high percentage of cement that was used in their manufacture.

The two sizes of magnesia sheathing or board, one-fourth of an inch and nine-sixteenths of an inch in thickness, were subjected to similar tests with the following results:

Fire test of magnesia sheathing $\frac{1}{4}$-inch thick, Chicago, 1904

Time of exposure.	Results.	Time of exposure.	Result.
Minutes.		*Minutes.*	
0	Sample placed in position.	10	Backing ignites.
2	Slight warping of sheathing.	$10\frac{1}{2}$	Sample removed, 3 gallons of cold water being immediately thrown on surface of same.
5	Slight upward bulging at center.		
6	Distillation of gas from wood back.		
9	Wood considerably charred.		

Fire test of magnesia sheathing $\frac{9}{16}$-inch thick, Chicago, 1904.

Time of exposure.	Results.	Time of exposure.	Results.
Minutes.		*Minutes.*	
0	Sample placed in position.	22	Charring of wood continues.
3	Slight warping of sheathing.	25	Wood back ignites.
$3\frac{3}{4}$	Sheathing begins to separate into two thicknesses, parting first at the upper edge.	$25\frac{1}{2}$	Samples removed, 3 gallons of cold water being thrown immediately on the surface of same.
6	Escape of vapor.		
11	Distillation of gas from wood backing.		

The surface of these two samples was softened and somewhat disintegrated, being readily cut with a knife where exposed, although retaining its original finish and appearance, with the exception of a darkening in color. There was no scaling, but the cold water caused cracks to extend through the sheathing. The thicker sample showed more permanent warping after cooling than the others. The wood backing of the thinner magnesia sheathing was charred to a depth of about a quarter of an inch back of the exposed area. The extent of charring in the thicker sample was not determined. These experiments show conclusively that both these materials are superior to wood for the purposes for which they are manufactured, and that the asbestos lumber is considerably superior to the magnesia.

Such asbestos lumber, when employed in the construction of street railway and standard railway cars for covering the end framing, should prevent the cars from taking fire by any derangement of the electrical apparatus. Inclosing the circuit breakers in boxes of this material would prevent conflagration if there should be any defective arcing. There are a number of railway companies that are beginning to use this material, and the Street Railway Journal of August 20, 1904, states that the New York City Railway Company is using this asbestos for the lower parts of new double-truck cars which they have recently built.[a] The Interborough Rapid Transit Company is also using asbestos board for various insulating purposes in the New York City subway. The General Electric Company is using the asbestos building lumber for finger shields, arc deflectors, barriers, panels, hot-air ovens, linings, and also under floors. The Brooklyn Rapid Transit Company is using asbestos building lumber in their new cars, the specifications providing that the underflooring of these cars shall be covered with asbestos building lumber of not less than one-quarter of an inch in thickness. The Montreal Street Railway Company has also recently specified that this material shall be used in new cars that are being built for them by the J. G. Brill Company and the Niles Manufacturing Company.

Another type of asbestos building material that is beginning to be used quite extensively is asbestos board or sheathing for roofing and a similar material for side walls.

The materials of this sort examined were manufactured by the H.W. Johns-Manville Company, and are composed of strong burlap or canvas foundation, having asbestos felt on the under side, and on the upper side either one sheet of saturated asbestos felt finished with a sheet of plain asbestos or two sheets of saturated asbestos felt. The whole is cemented together with a specially prepared acid-proof and waterproof compound, and is compressed into a compact, flexible roofing sheet. This kind of roofing gives fireproof qualities to the roof, and there are now many manufacturing plants that use this material

[a] Street Railway Journal, August 20, 1904.

quite extensively as a covering for their buildings, not only on the roof but on the side walls also—as, for example, the Standard Plate Glass Company, Butler, Pa.; the Allis-Chalmers Company, Chicago plant; the New England Cotton Yarn Company, New Bedford, Mass.; the Northwestern Malleable Iron Company, Milwaukee, Wis.; the Boyer Machine Company, Detroit, Mich., etc.

An asbestos shingle has recently been patented (August 30, 1904) by Messrs. Keasbey & Mattison which is composed of asbestos fiber and hydraulic cement. These shingles were examined by the writer, and are much stronger than slate and lighter in weight. They are made in squares 4½ inches on a side, with two corners of the square truncated. They are manufactured in three colors—gray, slate, and brick or tile red.

There has been kept in mind in the manufacture of these asbestos building materials the preparation of materials that would not only have the requisite strength and the desired fireproofing qualities, but that would also be attractive in appearance and be easy of manipulation and application.

It will be seen from what has been said that there has been a considerable advance made during the last few years in the utilization of asbestos in the manufacture of building materials, and that it is now possible to substitute these asbestos building materials for wood and building paper in almost any kind of building that may be constructed, as the asbestos board is now manufactured in such shape that it can be stained, polished, and finished to nearly as high a degree as wood. It can also be made very tough, so that it can be used to advantage as flooring. Although there will not be, perhaps, a general use of these asbestos materials for decorative purposes in private houses, they should be used to a considerable extent in public buildings and hotels, and especially in theaters and other buildings that are used for large gatherings. With the materials that are now manufactured from asbestos it would be possible in the construction of a theater to eliminate all woodwork and even cloth, as asbestos carpets could be used on the floors, and asbestos cloth could be used for upholstering chairs and for curtains and shades to windows. These materials are considerably more expensive than the corresponding wood or cloth, but they will wear as long, if not longer, and in addition they are fireproof, which would add to the safety of those patronizing the theaters as well as reduce the cost of insurance.

The use of asbestos materials in building has been considered chiefly from the standpoint of fireproofing; yet there is another and perhaps as important a reason for their employment, and that is for preserving an even temperature in the building erected. This applies both to those regions where there is extremely hot weather of long duration, as in the Southern and Southwestern States, and also to regions of long continued cold weather. Houses so built as to be surrounded by asbestos should be cooler in summer and warmer in winter than other houses. Where such roofing and side-wall material as has been described can be utilized it will serve for three purposes: As a covering for the building, as a fireproof material, and to keep out the heat in summer and to keep in the heat of the heating apparatus in winter. When it is impracticable, as in framed dwelling houses, to use the materials described, there are various asbestos sheathing papers, or better asbestos building papers up to one-eighth of an inch in thickness, that can be used between the sheathing boards and the clapboards or weatherboards on the side walls and just underneath the shingles of the roof. An experiment with these materials is now being made on a house in North Carolina which is in process of construction. Asbestos material is being used between the flooring of both the first and the second floors; asbestos mill board a quarter of an inch thick or two sheets of one-eighth inch asbestos board are used to wrap all joists that come in contact with the chimneys, and all wood is separated from the chimneys by means of this same material. All electric light wires and connections are separated from the woodwork by asbestos mill board or paper. The furnace, the furnace pipe, and the hot-air flues are also all separated from woodwork by asbestos board or paper. Thus it is seen that asbestos can be used in considerable quantity and to good advantage in a private residence, and while the first outlay adds somewhat to the cost of the house, at the same time it reduces the chances of fire, makes the house more comfortable both in summer and in winter, and reduces the cost of insurance.

OCCURRENCES AND LOCALITIES.

During the year 1904 many samples of asbestos were received for examination, but in nearly all cases they were of the amphibole variety. There were two, however, from Arizona that were of the chrysotile asbestos.

The amphibole variety occurs much more commonly than the chrysotile, being usually found in granitic or schistose rocks, either in pockets or in well-defined veins, and occurring in such quantity and forming such a 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 account of the length of fiber of this asbestos—occasionally over 2 feet—and of its perfect fibrous condition, attempts are constantly being made to utilize the mineral on a large scale for commercial purposes. The lack of strength of its fibers, however, prevents its being used in any very large quantity, and the demand for this amphibole variety is consequently small, being for those purposes where strength of fiber is not an essential quality.

The chrysotile asbestos is always found in serpentine rocks, and 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 asbestos. The strength of fiber of this asbestos is sufficient to permit its being woven and spun like wool or cotton.

Nearly all of the asbestos mined in the United States is of the amphibole variety, which is obtained from near New Hartford, Conn., from Sall Mountain, Georgia, and from near Bedford City, Bedford County, Va. Small quantities of chrysotile asbestos have been mined at Dalton, Mass., and in the Grand Canyon, Arizona.

No new deposits were reported during 1904, and all the mining and development work was confined to the known localities. On account of the quantity of the asbestos exposed and of its quality, the deposits in the Grand Canyon, Arizona, are attractive. The mechanical difficulties to be overcome in transportation are great, but not insuperable. A short description of these deposits follows:

GRAND CANYON ASBESTOS DEPOSITS, ARIZONA.

The asbestos deposits in the Grand Canyon of the Colorado River, Arizona, belong to the Hance Asbestos Mining Company of New York City, and are located in the Grand Canyon mining district, Coconino County, Ariz., on the north side of the Colorado River, about 70 miles a little west of north of Flagstaff, the county seat. The deposits are near the bottom of the Grand Canyon, about 4,900 feet below the rim, with a portion of the property rising to about 1,500 feet above the river. The nearest point on the railroad is Grand Canyon at the terminus of the Grand Canyon Railroad, which connects at Williams, a distance of 63 miles, with the main line of the Sante Fe Railroad. There is a good wagon road from Grand Canyon Station to the head of Grand View and Red Canyon trails, which lead from the rim to the bottom of the canyon and are 14 and 19 miles, respectively, from Grand Canyon Station. Both these trails are in good condition, and pack trains could carry from 80 to 100 pounds per burro or from 175 to 210 pounds per mule. Grand View, a United States post-office, is on the rim between the two trails.

The only present means of crossing the river to the asbestos deposits, which are on the north side, is by rowboat. With the installation, however, of a cable and an aerial tramway from the south to the north bank, at an elevation of approximately 1,200 feet above the river, the distance from the rim to the crossing point of the river would be reduced from three to five miles and there would also be

1,200 feet less of climbing. The property extends for a distance of about 9,000 feet down the river from the crossing point.

The rocks of the district in which the asbestos occurs consist of the Algonkian series of sedimentary rocks, lying unconformably beneath the Cambrian and the Carboniferous sedimentary rocks, which extend above them from 3,200 to 4,000 feet. Beneath the Algonkian sedimentary rocks are the Archean series, consisting of granites and gneisses, cutting which are numerous pegmatitic dikes. Between these two latter series of rocks there is a dike of basaltic rock which penetrates in some cases the strata of the Algonkian sediments, and is separated from the igneous rocks below by a strata of conglomerate which is very constant. Occasionally, however, this basaltic rock is in direct contact with the igneous rock below. These rocks dip at an angle of about 12° to 15° toward the east, and have a general strike of about N. 20° W. They also pitch about 10° toward the north. They are cut out by the Tonto sandstone of the Cambrian series at an elevation of about 1,400 feet just west of claim 15. From this point they dip uniformly toward the east and disappear under the river at a distance of from 10,000 to 10,100 feet. Within this distance these rocks are faulted four times, the displacement being from 10 to 50 feet; the faults are normal.

This basaltic dike has broken through the strata of the sediments (in some cases breaking off and inclosing within itself masses of some of these sedimentary rocks), and small dikes of similar rock were observed cutting across the strata at two other points, one a third of a mile farther up the canyon and directly across the river from the north of Red Canyon Creek and the other 1 mile up Red Canyon and on its western wall. This basaltic dike is from 30 to 70 feet in thickness, and along its contact with the sedimentary rocks, whether they are above or below or included within this rock, it is more or less altered to serpentine. In some instances where the seams of the basaltic dike have penetrated into the strata of the sedimentary rocks, they are completely altered to serpentine, and it is in association with these serpentinized areas of the basaltic rock that the asbestos is found. In some instances the basaltic rock is in contact with shales, and when this is the case there has been little or no serpentine formed. In most cases, however, the basalt is in contact with limestone, and then the serpentine areas are very constant, although they are only from a few inches to 18 inches and, in very rare cases, to 24 inches in thickness. The chrysotile asbestos is found only in those areas of the basaltic rock that have been serpentinized. As has been stated, these areas are almost constant for the whole 9,000 feet of the claims, although the asbestos varies very widely in length of fiber and in quality.

One noticeable exception to the usual occurrence of asbestos is the regularity of the seams. In some instances they are constant for a distance of 150 feet or more. Another difference is that instead of a thick mass of serpentine containing numerous seams of asbestos, the Grand Canyon deposit is a thin body of serpentine with but two or three prominent seams, which are, however, regular and nearly constant.

Most of the development work has been done near the western end of the property on what is known as Claim 14 or Wool Claim. The asbestos deposits have been developed at different points on this claim, following three different seams or zones of serpentine, which are in contact with three distinct layers of limestone. Openings were made on the upper and lower contact of a middle seam of basaltic rock and on the extreme upper contact. At the middle opening a tunnel has been run for a distance of about 75 feet in a direction N. 10° E. following the pitch of the rock, which is about 10° N. From this tunnel cross cuts have been driven and there has been considerable stoping. Just to the north of the mouth of the tunnel a quarry face has been opened for a distance of 126 feet in length and 20 feet in height, which exposed asbestos for a small area near the bottom of the face of the quarry. The asbestos seams, as exposed in the quarry and in the underground workings, vary considerably in width, widening, and pinching, and sometimes splitting up into a number of seams in like manner as has been observed in all deposits of chrysotile asbestos. The quality of the asbestos is exceptionally good and equal to the Canadian. This claim lies about 1,300 feet above the level of the river.

The next point at which there has been considerable development work is near the center of the property on Claim 8. The deposit on this claim has been developed extensively by means of quarrying, and the asbestos is exposed for a distance of about 160 feet. Asbestos of splendid quality, ranging from three-quarters to one and one-half inches in length, has been obtained from this claim. One peculiar quality of this asbestos is the beautiful golden color which it assumes in the massive specimens, although the individual fibers are pure white and very silky. In the mass it is almost transparent.

The third point at which there has been considerable development work is near the eastern end of the property, where a quarry face about 25 feet in length has been opened from which two tunnels, one about 10 and the other about 20 feet long, have been drifted on the asbestos seam. Some of the asbestos fiber from this claim was 3 inches in length, but it is not of as good quality as that obtained from Claim 14 and Claim 8.

Although this property is located at the bottom of the Grand Canyon, thus making the cost of transportation of the asbestos to the railroad very high, still there are no mechanical problems in connection with the mining and the transportation of this asbestos that can not be readily overcome when it has been definitely and positively determined that there is a sufficient quantity of the asbestos to warrant the outlay necessary. The quality of the asbestos, which is of the best, is a practical guarantee of a constant demand for any of the material that may be mined.

PRODUCTION.

The production of asbestos in the United States in 1904 was considerably in excess of that of 1903, and was obtained principally from the deposits in Georgia and Virginia, with a small quantity from Massachusetts. The total quantity amounted to 1,480 short tons, valued at $25,740, an average value of about $17.40 per ton. This production is an increase of 593 tons in quantity and of $8,980 in value as compared with that of 1903, which amounted to 887 short tons, valued at $16,760. The relatively small increase in value as compared with the increase in tonnage is due to the smaller production of chrysotile asbestos in 1904 as compared with the production of 1903. With the exception of the small quantity of chrysotile asbestos from Massachusetts, the production of 1904 was all of the amphibole variety. The output in 1904 is the largest quantity that has ever been produced in the United States in a single year, the next largest being in the year 1882, when the output was 1,200 tons, valued at $36,000.

The following table shows the production of asbestos in the United States and its value since 1880:

Annual production of asbestos in the United States, 1880–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1880	150	$4,312	1893	50	$2,500
1881	200	7,000	1894	325	4,463
1882	1,200	36,000	1895	795	13,525
1883	1,000	30,000	1896	504	6,100
1884	1,000	30,000	1897	580	6,450
1885	300	9,000	1898	605	10,300
1886	200	6,000	1899	681	11,740
1887	150	4,500	1900	1,054	16,310
1888	100	3,000	1901	747	13,498
1889	30	1,800	1902	1,005	16,200
1890	71	4,560	1903	887	16,760
1891	66	3,960	1904	1,480	25,740
1892	104	6,416			

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 following table:

Value of asbestos imported and entered for consumption in the United States, 1869–1904.

Year ending—	Unmanufactured.	Manufactured.	Total.	Year ending—	Unmanufactured.	Manufactured.	Total.
June 30—				December 31—			
1869		$310	$310	1887	$140,264	$581	$140,845
1870		7	7	1888	168,584	8,126	176,710
1871		12	12	1889	254,239	9,154	263,393
1872				1890	252,557	5,342	257,899
1873	$18		18	1891	353,589	4,872	358,461
1874	152		152	1892	262,433	7,209	269,642
1875	4,706	1,077	5,783	1893	175,602	9,403	185,005
1876	5,485	396	5,881	1894	240,029	15,989	256,018
1877	1,671	1,550	3,221	1895	225,147	19,731	244,878
1878	3,536	372	3,908	1896	229,084	5,773	234,857
1879	3,204	4,624	7,828	1897	263,640	4,624	268,264
1880	9,736		9,736	1898	287,636	12,897	300,533
1881	27,717	69	27,786	1899	303,119	8,949	312,068
1882	15,235	504	15,739	1900	331,796	24,155	355,951
1883	24,369	243	24,612	1901	667,087	24,741	691,828
1884	48,755	1,185	49,940	1902	729,421	33,011	762,432
December 31—				1903	657,269	32,058	689,327
1885	73,026	617	73,643	1904	700,572	51,290	751,862
1886	134,193	932	135,125				

As is seen from these two tables, the value of the asbestos imported into the United States in 1904, as compared with the home production, was as $751,862 is to $25,740, the value of the home production being about 3.4 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 is from Canada, there is given in the following table the production of this mineral in that country:

Annual production of asbestos in Canada, 1879–1904.

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	1904	[d] 48,646	1,180,244

[a] Including asbestic.
[b] Including 10,197 tons of asbetic.
[c] Including 10,548 tons of asbestic.
[d] Including 13,011 tons of asbestic.

This table shows a decided increase in quantity and value of the production of Canadian asbestos in 1904 as compared with that of 1903. The output, 48,646 short tons, is the largest on record, and the value, $1,180,244, has been exceeded only by the value of the output of 1901.

FLINT AND FELDSPAR.

By Heinrich Ries.

FLINT.

PRODUCTION.

The production of flint or quartz in 1904 amounted to 41,490 short tons of crude flint, valued at $28,890, and 10,780 short tons of ground flint, valued at $71,700, a total of 52,270 short tons, valued at $100,590. This is a decrease from 1903, as a number of quarries were idle. The production for 1904 is given in the following table, the value of the crude material being that given at the mines, and the value of the refined that given at the mills. This is included only in the cases where the firm mining the flint grinds its own material.

Production of flint in the United States in 1904, by States.

State.	Crude.		Refined.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Connecticut	(a)	(a)	(a)	(a)
Maryland	33,371	$15,458	6,524	$44,100
New York	(a)	(a)		
North Carolina	(b)	(b)		
Pennsylvania	8,119	13,432	4,256	27,600
Total	41,490	28,890	10,780	71,700

[a] Included under Pennsylvania. [b] Included under Maryland.

These figures do not represent the entire quantity of flint consumed annually in the United States, for much is imported from Europe in the form of rolled flints. The value of flints and flint stone unground imported in 1904 was $94,793.

The production of flint from 1892 to 1904 was as follows:

Production of flint in the United States, 1892–1904.

Year.	Crude.		Ground.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*		*Short tons.*	
1892	[a]22,400	$80,000			22,400	$80,000
1893	[a]33,231	63,792			33,231	63,792
1894	[a]42,560	319,200			42,560	319,200
1895	[a]13,747	21,038			13,747	21,038
1896	[a]12,458	24,226			12,458	24,226
1897	[a]13,466	26,227			13,466	26,227
1898	[a]21,425	42,670			21,425	42,670
1899	[a]29,852	180,345			29,852	180,345
1900	18,611	34,553	13,884	$51,798	32,495	86,351
1901	16,777	30,602	17,643	118,605	34,420	149,297
1902	20,295	35,046	16,070	109,163	36,365	144,209
1903	40,046	38,736	15,187	118,211	55,233	156,947
1904	41,490	28,890	10,780	71,700	52,270	100,590

[a] Includes both crude and ground.

FELDSPAR.

PRODUCTION.

The production of feldspar in 1904 amounted to 19,413 short tons of crude feldspar, valued at $66,714, and 25,775 short tons of ground feldspar, valued at $199,612, a total of 45,188 short tons, valued at $266,326. This is an increase in quantity of 3,297 short tons, and in value of $9,593, as compared with the output for 1903. It will be noticed that a smaller percentage of the total 1904 production was reported as being sold in ground form and a larger quantity as being sold in crude form.

The figures of production given for 1904 do not show the entire quantity of feldspar consumed in this country annually, for some is imported from Canada.

The production for 1904 is given below, the value of the crude material being that given at the mines, and the value of the refined that given at the mills when ground by the firm owning the mine.

Production of feldspar in the United States in 1904, by States.

State.	Crude.		Refined.	
	Quantity.	Value.	Quantity.	Value.
	Short tons.		*Short tons.*	
Connecticut	2,163	$6,274	8,456	$63,228
Maine	(a)	(a)	(a)	(a)
Maryland	13,492	50,670	(b)	(b)
New York	(b)	(b)	(b)	(b)
Pennsylvania	3,758	9,770	17,319	136,384
Total	19,413	66,714	25,775	199,612

[a] Included under Connecticut. [b] Included under Pennsylvania.

The production of feldspar from 1892 to 1904 is given in the following table. The figures since 1895 represent statistics collected directly by the United States Geological Survey, and are more approximately correct than those for preceding years.

Production of feldspar, 1892–1904.

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
1904	19,413	66,714	25,775	199,612	45,188	266,326

[a] Includes both crude and ground.

DEVELOPMENTS.

The feldspar deposits north of Wausau, Wis., still remain undeveloped; there is undoubtedly a large quantity of the material available.

GLASS SAND AND OTHER SAND.

By A. T. Coons.

PRODUCTION.

In 1902 and 1903 the value of sand crushed from sandstone and used for glass sand, which had previously been included in the figures given for stone, was separated, and, including other sand mined for glass manufacture, was published as a separate report from that on stone. In collecting the figures for these years a considerable value for sand used for molding, building, grinding and cutting glass, for sawing stone, for filtration purposes, etc., was ascertained; and in 1904, in addition to the figures for glass sand, the figures for molding sand have been secured, and also for a large quantity of sand used for building purposes, as well as for small quantities used for the various other purposes enumerated.

The total output of sand in the United States in 1904, as reported to this office, was 10,679,728 short tons, valued at $5,748,099.

The glass sand increased in production from 823,044 short tons in 1903 to 858,719 short tons in 1904, an increase in quantity of 35,675 tons, with a decrease in value from $855,828 in 1903 to $796,492 in 1904, a decrease of $59,336.

The molding sand produced in 1904 was reported as 3,439,214 short tons, valued at $2,125,370, and the building sand as 4,501,467 short tons, valued at $1,783,749.

The remainder of the output was furnace, fire, and engine sand, and sand for other purposes, such as filtration, grinding and cutting glass, grinding stone, etc.

The following tables show the value of sand produced in 1903 and 1904, by States, the table for 1903 giving the value of glass sand and of the comparatively small quantity of other sand, and the table for 1904 showing the figures for glass sand, molding sand, a close approximation of the building sand, and of the sand for other uses:

Production of glass sand and of other sand in the United States in 1903 and 1904, by States.

[Short tons.]

1903.

State.	Glass sand.		Engine sand.		Furnace sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
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	41,039
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	305,989

State.	Building sand.		Other uses.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
California	....	....	....	....	6,075	$5,225
Georgia	....	....	....	....	4,900	4,410
Illinois	57,245	$27,837	162,813	$94,835	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	33,052	228,683	126,036
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 1903 and 1904, by States—Continued.

1904.

State.	Glass sand.		Molding sand.		Engine sand.		Fire sand.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama			88,675	$36,584				
Arkansas			4,495	2,382	3,000	$1,500		
California	9,091	$11,614	6,150	4,600	19,339	4,733		
Colorado			11,734	6,011				
Connecticut			2,002	4,325				
Delaware			80	40				
Georgia	3,600	3,600	73,386	30,463				
Hawaii								
Illinois	219,784	143,954	574,488	363,090	8,250	2,120	7,000	$2,200
Indiana	3,860	2,715	170,145	64,276				
Iowa			6,224	4,877			31	25
Kentucky			386,330	222,542	7,750	4,400		
Maryland	24,081	28,281	600	900	10,000	4,000	150	162
Massachusetts	8,292	16,590	12,960	7,060				
Michigan			167,147	76,299				
Minnesota			9,972	9,228				
Mississippi			245	145				
Missouri	121,629	68,503	57,835	31,519	93,750	22,500	6,200	3,015
New Jersey	51,850	36,284	263,811	161,032			74,237	46,865
New York	3,720	3,676	320,825	262,997	9,848	5,631	5,700	5,050
Ohio	43,930	32,061	484,090	377,187	25,372	12,870	21,652	15,429
Pennsylvania	294,333	346,370	628,064	369,381	70,667	53,521	58,251	57,275
Tennessee	80	160	20,468	13,186	6,472	3,045	125	30
Texas			9,958	6,783				
Virginia			64,313	30,943	3,600	1,800		
Washington			1,300	2,500				
West Virginia	74,469	102,684	17,607	8,638	7,310	7,310		
Wisconsin			53,585	26,478				
Other States[a]			2,725	1,904				
Total	858,719	796,492	3,439,214	2,125,370	265,358	123,430	173,346	130,051

[a] Includes small production from Florida, Louisiana, Maine, North Carolina, Oklahoma, South Carolina, Utah, and Vermont.

Production of glass sand and of other sand in the United States in 1903 and 1904, by States—Continued.

1904—Continued.

State.	Furnace sand.		Building sand.		Other sand.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama			64,400	$16,615			153,075	$53,199
Arkansas			10,385	5,630	1,620	$810	19,500	10,322
California			1,591	1,736			36,171	22,683
Colorado	1,000	$850	12,840	5,675			25,574	12,536
Connecticut			9,360	2,250			11,362	6,575
Delaware	1,070	1,220					1,150	1,260
Georgia			11,245	4,149	150	150	88,381	38,362
Hawaii					2,895	8,708	2,895	8,708
Illinois	37,360	17,551	338,461	148,911	21,328	11,914	1,206,671	689,740
Indiana			177,338	62,395	275,750	79,773	627,093	209,159
Iowa	31	25	3,761	1,745	120	90	10,167	6,762
Kentucky	10,000	6,400	211,290	78,675	16,980	11,500	632,350	323,517
Maryland			100,550	79,175	41,000	106,750	176,381	219,268
Massachusetts			44,717	24,289	5,550	13,125	71,519	61,064
Michigan			69,656	30,898			236,803	107,197
Minnesota			34,500	14,800			44,472	24,028
Mississippi			4,500	4,973			4,745	5,118
Missouri	10,400	4,900	1,352,427	425,982	290,847	95,190	1,933,088	651,609
New Jersey	1,716	429	312,680	119,846	44,948	12,006	749,242	376,462
New York	8,965	3,657	122,255	49,119	162,427	52,567	633,740	382,697
Ohio	44,642	41,165	234,730	84,937	12,718	10,787	867,134	574,436
Pennsylvania	11,788	9,261	740,111	279,880	334,524	164,906	2,137,738	1,280,594
Tennessee			98,975	86,125	1,200	600	127,320	103,146
Texas			148,000	67,800			157,958	74,583
Virginia			267,264	123,842	4,357	3,482	339,534	160,067
Washington							1,300	2,500
West Virginia			89,916	39,556	1,588	1,216	190,890	159,401
Wisconsin			39,333	24,200	92,750	129,000	185,668	179,678
Other States[a]			1,182	546	3,900	975	7,807	3,425
Total	126,972	85,458	4,501,467	1,783,749	1,314,652	703,549	10,679,728	5,748,099

[a] Includes small production from Florida, Louisiana, Maine, North Carolina, Oklahoma, South Carolina, Utah, and Vermont.

VALUE.

The value of the sand varies greatly, according to purity, amount of work necessary to prepare it for use, distance from point of shipment or consumption, use to which it is put, etc. The values given in this report are as nearly as possible those obtained for sand ready for use, free on board at point of shipment. In the tables given sand is included varying in value from 8 cents to $6 per ton, the average price being about 50 cents.

In the case of many small foundries or where sand of no particular quality is desired for rough casting the sand is often obtained close to the foundry of quality sufficient to answer all purposes, there being no value for the sand other than the expense incurred in loading and hauling it to the foundry.

GLASS SAND.

The manufacture of glass requires a purer sand than that used for any other purpose, and glass sand is therefore higher priced than other sands. The chief impurities are iron, alumina, and clay, which color the glass or give it a cloudy appearance. These impurities are removed by washing and sometimes, in the case of iron, with a magnet. The purity of the sand used is regulated by the quality of the glass desired. Glass sand is mined in more or less pure state from deposits of sand, and it is also obtained as a rock easily disintegrated when exposed to the air, or from hard sandstones, which have to be crushed before being used. Glass sand is mined chiefly in Pennsylvania, Illinois, and West Virginia, although Missouri and Ohio have a considerable production.

A considerable amount of foreign sand is also used in this country for the manufacture of glass.

MOLDING SAND.

Sand plays a most important part in the manufacture of castings, and a knowledge of the composition of the mold and of the part the different ingredients play is of value both to the foundryman and to the sand producer.

The chief function a mold performs in making a good casting is to resist the pressure of the molten liquid in all directions and yet to allow air and any gas formed in the mold to escape freely during the process of running in the liquid. It must give a good surface and not stick to the cast. There must be no reaction between the molten metal and the mold, nor must the mold be affected by the high temperature of the liquid. Metallic oxides and lime or lime carbonate in the mold impair its refractory properties and, decomposing, form bubbles, or, vitrifying, adhere to the cast.

Molding sand or sands employed in making molds when metal molds are not used in casting vary greatly in quality and in value. They are used in molding all classes of gray iron, malleable iron, steel, cores, fine brass, and bronze castings, etc.

The sand required for these uses has decided characteristics according to the purpose of its use; but all sands to be of value must possess certain qualities of refractoriness, enabling them to withstand the heat of the molten metal without burning up, shrinking, or disentegrating.

The ingredient in sand giving the quality of refractoriness is silica, and a sand is said to be "fat" or "lean" according to the amount of silica it contains.

Lime and alkalis decrease the refractoriness by causing decomposition and disintegration, and clay, although refractory, bakes at a high temperature and causes shrinkage.

The sand must have tenacity, enabling it to take the shape of the mold and to retain this shape under the weight of the metal. Another necessary feature is that the mold must also crumble when the cast is removed and allow the material to be used as a mold again. The sand in the mold, if properly treated, may be used repeatedly, especially with the addition of some fresh sand.

The porosity of the sand is also an important feature. When the sand is pressed in the mold and shaped like the pattern it must still be sufficiently porous to enable the gases from the hot liquid to escape, and yet the pores must not be so large as to allow any of the metal to enter them. The porosity is dependent on the size of the sand grains and on the binder used in shaping up the sand in the molds. Too much water must be avoided in tempering the sand, otherwise the escaping steam when the hot material is poured into the mold is liable to give trouble, unless the porosity of the sand enables it to be carried off.

In case the sand contains a clayey binder it will become less porous at a high temperature on account of the baking of the clay, and an organic binder will burn out and the mold will become too porous. To secure good results the particles of sand should be rough and angular, and not smooth and round. The grains should be as uniform as possible and free from dust. The size of the grains depends upon the kind of work for which the sand is to be used, their fineness or coarseness also affecting the porosity.

The sand should be free from carbonates which decompose, or from any material which would disintegrate the sand.

For heavy pieces of work sand containing a clayey binder is used, the shrinkage making cracks which allow the vapor to pass off.

In work where loam is used, the material shrinks very much, and organic matter is added to counteract the shrinkage and to make the material porous.

In almost all cases the sand from various localities is different, and the success of a casting depends upon previous tests of the sand to determine its action under great heat and thereby to learn what materials should be added, if any, to give the best results.

In some countries, and to a small extent in this country, artificial sand is made by mixing clayey sand, alluvial sand, and sand from sandstone, driving the moisture from the first sands, and then grinding the three together.

The mold is usually prepared in two boxes which fasten together when in use, each box containing about half the pattern; a layer of dust, or of some fine dry material, is dusted on the surface between the two parts of the mold. The mold is formed by pressing the pattern, which is usually wooden and very exact, into the sand, and then removing it when the impression is made. If it is desired that the casting have a smooth finish, the surface of the mold is dusted with a layer of charcoal dust in fine castings, and of fine coal in heavier castings. These materials ignite in the presence of the hot liquid and form a thin layer of gas between the mold and the casting and thus, by preventing the liquid from pressing into the mold, give the casting a smooth surface.

If the casting is to have holes, spaces are made by putting cores into the mold. This core sand is, when the core is short, usually loam or very clayey sand; sometimes, however, it is rock sand; but longer cores require sand of more porosity.

Generally, molding sand occurs in more or less thin beds overlain by thin soil, which is easily stripped and the material easily mined. In many instances dealers take out the sand and either pay a royalty of from 6 to 15 cents per ton, or pay a fixed sum for all the sand in a stated mine or pit. Sometimes the owner of the sand markets it himself, but most of it is sold through the dealers. The value of the sand free on board at point of shipment ranges from 35 cents to $2 or $3 per ton, the cheapest sand being used for rough casting and small cores, and the highest priced sand for fine brass and bronze castings, the average price, however, being from 50 to 75 cents per short ton.

The largest part of the molding sand mined in the United States comes from Ohio, Pennsylvania, and Illinois, in the order named as regards value of output, New York, Kentucky, and New Jersey being next in rank. Sands from all these States are shipped all over the United States and enter into the export trade. Some years ago the sand from New York, in Albany County and the Hudson River Valley, was one of the chief sands used in the Middle West, but these have lately been succeeded by local sands. In Pennsylvania, and especially in Ohio, sandstone ground into sand is used for molding, especially for steel and core sand. Some beach sand, notably from Lake Michigan, New Jersey, and the south shore of Long Island Sound, is used for core sand, although most of this goes for building and concrete work.

Many of the furnaces and foundries on the northern boundary of the United States and or the lakes get sand from Canada.

BUILDING SAND.

Large quantities of sand dredged from the Ohio, the Mississippi, the Tennessee, and the Delaware rivers are washed, dried, and screened on board the dredges, and then enter into the enormous quantity of sand that is every year consumed in building operations. This includes some sand used also in the making of concrete for foundations. Lake and beach sands also enter into this trade. More sand is consumed for building and construction work than for any other purpose; and as for this purpose no especial purity is required, loamy sand and a mixture of coarse and fine sand as found in bank being used, this sand is cheaper than any other form of the product. When the sand contains much coarse material it is screened, the coarse being used for roads as gravel or for the roofs of buildings.

OTHER USES.

Filtration sand.—A sand high in silica, free from lime and organic matter, thoroughly washed and free from clay, and graded to certain standard specifications is necessary for this purpose. The fine sand remaining with filtration sand companies as a by-product is used by blast furnaces and steel-casting companies. It is also valuable for sand-lime brick. Sand dredged from rivers, when washed and rewashed and properly graded, is used as filtration sand.

Fire sand.—Fire sand is the white silica sand, generally ground from sandstone, and used for fire purposes by blast furnaces and by open-hearth steel and malleable-iron and steel furnaces, for tube welding by smelting and refining furnaces, and for ladle and cupola linings, etc.

Locomotive or engine sand.—This sand is for sanding tracks on steam roads and street railways. This requires a hard sand, graded to a definite size, which must be washed and dried thoroughly, so that it will run through the tube of a sand box freely.

Other uses.—Very fine-grained silica sand is also used as a filler and for making a hard finish on exposed woodwork, and as a glaze on pottery and sanitary ware. It is also used in the manufacture of paper and wall paper; for filling material for fireproof safes; for fireproofing, pottery, and crucibles; and for sanding woodwork, for strikers on match boxes, for sandpaper, and for various other purposes.

Bar sand, dredged from rivers, or a clean sharp pit sand not too coarse and with fairly even sized grain, is used for mixing mortar, plastering, cement mixing, and finishing, for manufacture of clay brick, and in making asphalt paving brick and asphalt paving.

Coarse, sharp, and hard sand is used in sand-blast machines; in stone sawing, polishing, and carving; in stone cleaning; in sand blasting rail joints, and in welding rails when already laid.

A comparatively new and important use for sand is in the making of sand-lime brick, which requires a silica sand, rather sharp and free from alkalies, thoroughly washed, and of a definite and even-sized grain.

ACKNOWLEDGMENTS.

Comparatively little study has been made of sands and material used in molding, and in this first endeavor to collect statistics of sands thanks are due to the foundry men for sending the names of dealers and producers, and to the producers and dealers for their courtesy in

furnishing information; also to the editor of The Foundry, Chicago, Ill., for active cooperation.

A detailed report on the molding sands of New York may be found in a paper by Mr. E. C. Eckel,[a] and the New Jersey Geological Survey has just published a report on the molding sands of New Jersey.[b]

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[a] Eckel, E. C., Twenty-first Rept. State Geologist New York, 1901, p. 93.

[b] Kümmel, H. B., and Hamilton, S. H., Ann. Rept. State Geologist New Jersey, 1904.

GRAPHITE.

By Joseph Hyde Pratt.

OCCURRENCE.

Graphite is a mineral that has always attracted considerable interest in the mining industry of the United States, on account of the many uses for which it is adapted and because the large demand for it is only partly supplied by the domestic production. The importation of graphite varies from eight to fifteen times the domestic production. The pure mineral graphite is composed simply of carbon, but is often impure from the presence of iron sesquioxide, clay, silica, mica, etc. Even the purest forms of graphite, as they are found in nature, will yield upon combustion from a fraction of 1 per cent upward in ash. Some of the graphite from the Ticonderoga, N. Y., deposits has given as low as 0.24 of 1 per cent of ash. This mineral crystallizes in the rhombohedral division of the hexagonal system, and, when crystallized, is usually in six-sided tabular crystals that are nearly always striated and whose faces are indistinct. It is commonly found in embedded, foliated masses, or in scaly, slaty, or micaceous masses; occasionally it is in granular to compact formation, and at other times it is of a decidedly earthy texture. It has a perfect basal cleavage, similar to a mica, and the thin laminæ are flexible, but not elastic. Graphite varies considerably in specific gravity—from 2.09 to 2.23—according to the amount of impurities. The hardness also varies for the same reason from 1 to 2. Graphite has a metallic luster when pure, and varies from this to dull and earthy, according to the percentage of impurities. The color for the same reason also varies from iron black to dark steel-gray. It has a greasy feel, is a conductor of electricity, is impervious to atmospheric influences, is combustible only at very high temperatures, and is very soft. It is these properties of graphite that make it of so much value in the arts and adapt it to such a large variety of uses.

Some of the common occurrences of graphite are as beds and embedded masses or scales in granitic rocks, gneisses, mica-schists, crystalline limestones, and pegmatites. Although rather widely distributed in nature and occurring in a great many localities, it has been found in but few deposits of such character as to be of commercial importance. In some instances the deposits have contained a sufficient quantity of graphite, but it was so intimately mixed with other minerals, as quartz (silica) and mica, that it has been impossible to separate the graphite at a sufficiently low cost for it to enter commercially into competition with graphite obtained from other deposits. The graphite from such deposits has proved in the laboratory to be of a good quality; but commercial processes have not yet been devised for its profitable separation. The more common deposits of this character are those in which the graphite is in the form of a graphitic schist, the graphite varying from 10 to 30 per cent of the rock.

Graphite deposits have been developed in many of the States, including Maine, New Hampshire, Massachusetts, Rhode Island, New York, Pennsylvania, Virginia, North Carolina, Georgia, Alabama, Ohio, Michigan, Wisconsin, Arkansas, South Dakota, Montana, Wyoming, Colorado, California, Nevada, and New Mexico. Besides these deposits, graphite has been found in small quantities in nearly all the western and eastern States.

In many of the States there is considerable variation in the quantity of graphite produced each year, and there is also considerable change from year to year in the number of producing States. Some of the States have been constant producers for many years, and these contain the largest and most valuable deposits of graphite that are known in the United States. The following are the producing States, given in the order of their importance: New York, Pennsylvania, Wisconsin, Michigan, Georgia, Alabama, Ohio, Nevada, and North Carolina.

The graphite deposits of New York are in the region of Lake George and southern Lake Champlain, and are found, according to Prof. J. F. Kemp[a] in four kinds of rock: (1) in pegmatite veins; (2) as veinlets of graphite; (3) in quartzites; (4) in crystalline limestones with associated gneissoid strata. Deposits representing all four of these occurrences are now being mined or developed. The graphite that occurs in the pegmatites is coarsely crystalline, and often gives the impression of being in great abundance; but as these pegmatites are developed the graphite is found to occur in bunches or pockets, and although these are usually very pure and do not demand so much mechanical concentration as deposits occurring in quartzites or limestones, still the uncertainty respecting the quantity of graphite that can be obtained from these pegmatites has made nearly all attempts to work them practically failures.

At Split Rock, near Essex, on Lake Champlain, there have been observed narrow veins or veinlets of graphite following fissures up to an inch in width that cross the gneisses. There is more or less vein quartz mixed with the graphite in these veins, but this could be readily eliminated; so that if a large deposit of this character could be found it would represent perhaps the richest and most desirable in the Adirondack district. The graphite deposits in the quartzites form regularly stratified portions of the sedimentary series, and the rocks

[a] Kemp, J. F., Bull. U. S. Geol. Survey No. 225, 1904, p. 512.

have been called graphitic quartzites. They are somewhat feldspathic and are associated with graniferous sillimanite-gneiss. The graphite occurs in scales of varying fineness, and varies in quantity from 5 to 14 per cent of the rock. Graphitic quartzites are irregular, pinching and swelling more or less. There are two methods of treatment of these quartzite rocks, one using a wet and the other a dry process.

In the mill at Graphite the graphitic quartzites are first stamped in California drop stamps and are then washed in buddles to a state of approximate purity. The final method of purification or concentration is a secret process. In the Lakeside mill the rock is crushed without water and carefully dried to eliminate all moisture, and the concentration is then performed by Hooper air jigs. Another mill has recently been erected at South Bay, an arm to Lake Champlain, about 6 miles northwest of Whitehall.

The principal deposits of the graphitic quartzites have been discovered chiefly in the town of Hague, on the western side of Lake George, and in the towns of Dresden and Whitehall, on both sides of South Bay, Lake Champlain. In the beds of crystalline limestone, which occur in the Algonkian strata of the Adirondacks and which vary from a maximum of about 100 feet down to a few inches in thickness, scales of graphite are scattered more or less abundantly. These limestones offer some commercial possibilities as sources of supply of graphite. The limestone can be easily crushed and would readily free itself from the graphite. One of the most serious objections to the utilization of these limestones as a source of graphite is that more or less phlogopite mica is also found in them; and, unless it could be readily handcobbed from that portion containing the graphite, it would present somewhat serious difficulties in the purification of the graphite.

As the New York graphite is of the crystalline variety, that State offers, perhaps, as promising a district for prospecting and developing graphite properties as any in the country.

In a number of the States, as in the North Carolina deposits in Wake and McDowell counties, the graphite occurs in schistose rocks, constituting from a small quantity up to 25 per cent or more of the rock. The occurrence of mica and some silica in these schistose rocks makes it difficult to separate a pure graphite from them. The Georgia graphite deposits, which have been producing rather extensively for the last year or two, are in the nature of a graphitic shale or slate, containing approximately 13 per cent of graphite. These deposits are located near Emerson, Bartow County, and the product mined is used as a colorer in the fertilizer trade. The material is not cleaned in any way, being simply pulverized so that 60 per cent of it will pass through a 24-mesh screen and all through an 8-mesh screen. The value of this material is, of course, very low, and in the total production of graphite in the United States it has increased the tonnage materially without adding very largely to the value.

In the Turret mining district of Chaffee County, Colo., a graphite deposit is being developed by the Ethel Gold Mining Company, of Detroit, Mich. Samples that have been examined show this deposit to be amorphous graphite of very good quality. This company is now erecting a mill at its mine for concentrating and refining the graphite.

During 1904 there was some development work carried on at the California graphite mines. At the Rhode Island deposits a new vein was opened in Tiverton, on the east bank of the Sakonnet River, by the Rhode Island Graphite Company, of Providence, R. I. Some graphite was produced also in Ohio, about 8 miles northeast of New Philadelphia, by the Goshen Coal Mining Company.

Natural graphite is divided into two classes, known as crystalline and amorphous, the former representing the graphite which has a crystalline structure and which in itself is a nearly pure carbon, although it may sometimes occur in very minute flakes, while all the other forms, of whatever occurrence and character, are referred to the amorphous class. The crystalline variety represents the graphite that can be used for all purposes for which this mineral is required; but, on account of its occurring much less commonly than the amorphous, its uses are limited to the manufacture of refractory products, lubricants, electrotypes, and pencils, for which purposes it is especially adapted on account of its freedom from all impurities. The amorphous variety, on the other hand, occurs much more abundantly in nature, but on account of the difficulty experienced in refining the crude ore, many of the deposits containing this variety of graphite are not at the present time of commercial value. On account of this difficulty of purification, the amorphous graphite is not used in the manufacture of lubricants nor of the better quality of pencils, for electrotypes, etc., except in a few instances where a very pure product is obtained.

The bulk of the world's supply of the crystalline graphite is obtained from the island of Ceylon. These deposits are located in the western and southwestern portions of the island, the mineral area in which the graphite occurs being approximately 95 miles long in a north and south direction, with a width of 35 miles at its northern and of 43 miles at its southern end. The commercial graphite deposits occur in veins which traverse a garnetiferous granitic rock. These veins vary in width from a few inches to 8 feet, and one has been followed to a depth of 720 feet; but from all accounts such a depth is exceptional. Horizontally the veins are very irregular and limited, and well-defined veins constantly pinch out. There does not seem to be any evidence of a main lode or series of lodes in any portion of the district, but there appear to be two zones of the country rock, 4 miles and upward in width (the widest part being 20 miles), which seem to contain the veins that carry the graphite. These deposits have been described in some detail by Mr. George S. Stonier in a paper presented before the Institute of Mining Engineers of London, entitled "Graphite Mining in Ceylon and India."[a] He states that horizontal veins seem to be entirely disconnected, and that not only is there no indication of a main lode, but that there does not seem to be even a series of connected lodes or veins. A vein 4 inches wide is considered as profitable mining. The largest mass of graphite which has been discovered in this district weighed nearly 6 tons. From the data at hand, Mr. Stonier considers that the fissures were formed first, and that the graphite, quartz, etc., were deposited in them. The graphite may have been introduced by sublimation not of carbons but of hydrocarbons, as is suggested by the fact that a deposition of graphite-like material is often found in the cracks of upper layers of coke made in the closed ovens.

There are about 300 mines and quarries in operation, which, with the exception of 3, are all worked by the old native methods. Attempts have been made to work the graphite deposits by modern methods, but on account of the uncertainty of the occurrence of the graphite it has been found more profitable thus far to work the mines according to the old native methods. This generally means that the graphite deposits are simply worked to water level. This is done by means of shallow shafts sunk 50 or 60 feet, the ore being hoisted in barrels and the mineral conveyed in boxes to the dressing sheds, where it is roughly picked and packed in barrels for transit to the shipping port, either Colombo or Galle. Here the graphite is re-sorted and screened, the larger pieces being broken up. In some cases the poorer portions are further concentrated by washing. It is then classified into five sizes, known as lump, ordinary, chips, dust, and flying dust, and these grades are further divided according to quality. It is estimated that Ceylon furnishes about 30 per cent of the world's output of graphite and 75 per cent of the value. The United States is the largest importer of Ceylon graphite. The bulk of the amorphous graphite is obtained from Austria-Hungary.

Mexico is beginning to produce some graphite, which is being exported to the United States, principally from Sonora. Recently notice has been sent by Mr. F. W. Goding, United States consul at Newcastle, New South Wales,[b] that graphite mines had been opened and developed on one of the slopes of Mount Bopple, about 3 miles from Netherley station on the North Coast Line railroad, and within 35 miles of the seaport of Maryborough. He states that the material is of very good quality, and that at a depth of 32 feet 35 tons of graphite were obtained in cutting through the ore deposit, and that on continuing to sink the shaft fine seams varying from 1 to 6 feet in width were encountered. Several shipments have been made of the graphite to be manufactured into paint, and trial shipments have been sent to both England and Germany.

[a] Trans. Inst. Min. Eng., vol. 27, pt. 5, 1904, and Mining Mag., London, January, 1905.
[b] U. S. Cons. Reports, Jan. 21, 1905.

USES.

The uses of graphite are very numerous and varied. One of the chief uses is in the manufacture of crucibles, retorts, and other refractory apparatus, and for this purpose it is the crystalline variety that is most extensively used. It has been estimated that 55 per cent of the crystalline graphite is used for this purpose and only a very small percentage of the amorphous variety. Other uses of the crystalline graphite are as follows: About 15 per cent of the total production for the manufacture of stove polishes, about 10 per cent for foundry facings, about 5 per cent for paint (the bulk of the graphite used for this purpose being of the amorphous variety), and 15 per cent in the manufacture of pencils, powder glaze, electrotyping, steam packing, and electrical supplies. With the exception of the Georgia amorphous graphite, which is used in coloring fertilizers, the bulk of the amorphous graphite mined is used in the manufacture of paint and for foundry facings.

In the manufacture of good grades of pencils, lubricants, electrical supplies, and crucibles it is essential that a nearly pure graphite be used, this being especially true of the lubricants and of the best quality of pencils. For paints and foundry facings purity is not so essential, and therefore the amorphous varieties can be used with as good results as the crystalline. The uses of graphite as a lubricant have been constantly increasing, and now there are many forms of graphite lubricants on the market. Many reasons are advanced for the more universal introduction of graphite as a lubricant, such as the fact that the graphite permanently fills up all the minute irregularities or roughnesses on metal surfaces, thus making them absolutely smooth and even; that it also reduces frictional resistance; is not crushed or squeezed out by great pressures; prevents sizing and cutting; is unaffected by any degree of heat that would be attainable in a cylinder or bearing; is not decomposed by the action of anything to which it would be subjected, and that it does not corrode metals with which it would come in contact. It must, however, be an absolutely pure graphite, without any gritty matter or iron oxide in it. About 1,200 tons of amorphous graphite are used in the manufacture of paints. In some of the States the whole production of graphite is used for this purpose, while in others the whole production is used for foundry facings. Only a few of the producers utilize the graphite themselves for manufacture into commercial products, and it is usually sold direct by the miners or producers to the manufacturers of paint or to foundry men.

Besides the crystalline and amorphous graphite, there is the artificial graphite, which nearly equals in quantity the production of crystalline graphite in this country. This product is used in the manufacture of electrical supplies, pencils, crucibles, and the other various purposes for which the natural graphite is used.

PRODUCTION.

During 1904 the value of the total production of graphite amounted to $341,372 as compared with the total value of $225,554 in 1903, an increase of $115,818, due principally to the large increase in the Pennsylvania, Wisconsin, and Georgia productions.

Crystalline graphite.—The production of crystalline graphite in the United States during 1904 amounted to 5,681,177 pounds, valued at $238,447, as compared with the production of 4,538,155 pounds, valued at $154,170, in 1903, an increase of 1,143,022 pounds in quantity and of $84,277 in value. Most of the crystalline graphite reported was refined, but little having been sold in the crude state. The average price per pound received for the 1904 production was 4⅕ cents, which is four-fifths of a cent higher than the average price received per pound in 1903.

Amorphous graphite.—The production of amorphous graphite in 1904 amounted to 19,115 short tons, valued at $102,925, or $5.38 per ton, an increase of 2,524 tons in quantity and of $31,541 in value as compared with the production of 16,591 short tons, valued at $71,384, or $4.30 per ton, in 1903. The average price per ton is still very low, and is due to the Georgia production, which is sold far below the price received for graphite that is used for the many purposes enumerated above.

The following table shows the annual production of graphite from 1880 to 1904, inclusive, the refined crystalline product being given in pounds and the amorphous in short tons:

Production of natural graphite, 1880–1904.

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	182,108
	short tons	4,739	
1903	pounds	4,538,155	225,554
	short tons	16,591	
1904	pounds	5,681,177	341,372
	short tons	19,115	

Artificial graphite.—The production of artificial graphite has been steadily increasing since its introduction upon the market in 1897, and in 1904 there was a very large increase in the production as compared with that of 1903. This is due to its being introduced into the manufacture of other graphite products besides those used for electrical purposes. The quantity of this variety of graphite that was manufactured in 1904 amounted to 3,248,000 pounds, valued at $217,790, which is the largest quantity produced in any year since its first introduction on the market. This is an increase of 628,000 pounds in quantity and of $39,120 in value as compared with the 1903 production of 2,620,000 pounds, valued at $178,670. The average price per pound received for the 1904 product was 6.7 cents, a decrease of 0.12 cent as compared with the price 6.82 cents per pound received for the 1903 product. In the table following are given the quantities and values of the graphite manufactured for each year since 1897:

Production and value of artificial graphite, 1897–1904.

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	4.76
1902	2,358,828	110,700	4.70
1903	2,620,000	178,670	6.82
1904	3,248,000	217,790	6.71

This table shows clearly the increase in the demand for artificial graphite, and when this table is compared with the one for domestic production it is at once recognized that the artificial graphite has assumed a very important position in the graphite industry of this country.

IMPORTS AND EXPORTS.

The annual importation of graphite into the United States each year far exceeds the domestic production and amounted in 1904 to 12,674 tons, valued at $905,581. This is the lowest importation in quantity since 1897, and, with the exception of 1901, the lowest in value since 1898. 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. In the following table are given the quantity and value of the graphite imported into the United States from 1867 to 1904, inclusive:

Graphite imported into the United States, 1867–1904.

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	7,577	548,613	....	548,613
1874	5,600	382,591	....	382,591
1875	2,329	122,050	....	122,050
1876	1,530	150,709	17,605	168,314
1877	3,778	204,630	18,091	222,721
1878	3,022	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	4,188	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	....	1,390,142
1901	14,625	895,010	....	895,010
1902	18,201	1,168,554	....	1,168,554
1903	16,007	1,207,700	....	1,207,700
1904	12,674	905,581	....	905,581

ANNUAL CONSUMPTION OF GRAPHITE.

In order to show more clearly the annual quantity of graphite consumed in the United States each year there is given in the following table the quantity and value of the natural and artificial productions of graphite and of the imports.

Annual consumption of graphite in the United States, 1899–1904.

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	18,860	225,554	1,310	178,670	17,928	1,207,700	....	13,365	38,098	1,598,559
1904	21,956	341,372	1,624	217,790	14,195	905,581	[a] 148	12,417	37,627	1,452,326

[a] Estimated.

This table will emphasize the importance of the graphite industry in the United States, and also the benefit that would be derived by this country if large deposits of commercial graphite should be located in some of the States. It will also be noticed from this table that there has been 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. Leaving out in 1903 and 1904 the production of the Georgia graphite used for coloring fertilizers, there was still an increase in the quantity of graphite consumed as compared with 1901 and 1900.

CANADIAN PRODUCTION.

The Canadian graphite is obtained chiefly from the Provinces of Quebec and Ontario, with smaller quantities occasionally from New Brunswick and Nova Scotia. Although graphite is known to occur in the Provinces of Quebec and Ontario in some quantity, the deposits have not been developed to any great extent, and the production of graphite has never been very large, and for the last three years there has been a very decided decrease in the quantity and value of their production. In 1904 the quantity of graphite produced was 452 short tons, valued at $11,760, a decrease as compared with the production of 738 short tons, valued at $23,745, in 1903. The following table gives the quantity and value of the annual production of graphite in Canada from 1886 to 1904:

Annual production of graphite in Canada, 1886–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Short tons.			*Short tons.*	
1886	500	$4,000	1896	139	$9,455
1887	300	2,400	1897	436	16,240
1888	150	1,200	1898	([a])	13,698
1889	242	3,160	1899	1,310	24,179
1890	175	5,200	1900	1,922	31,040
1891	260	1,560	1901	2,210	38,780
1892	167	3,763	1902	1,095	28,300
1893	None.	None.	1903	738	23,745
1894	69	223	1904	452	11,760
1895	220	6,150			

[a] Quantity not reported.

WORLD'S PRODUCTION.

In the following table is shown the world's production of graphite by countries from 1896 to 1903:

World's production of graphite, 1896–1903.

[Quantity in metric tons.]

Country.	1896.		1897.		1898.		1899.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	933	$48,460	1,589	$65,730	1,878	$75,200	3,424	$167,106
Austria	35,972	410,081	38,504	439,610	33,062	421,058	31,819	395,280
Canada	126	9,455	396	16,240	....	13,698	1,188	24,179
Ceylon	10,463	414,405	19,275	1,159,885	78,509	9,243,263	29,037	2,904,970
Germany	5,248	72,108	3,861	66,126	4,593	97,916	5,196	120,250
India	....	....	61	316	22	110	1,548	7,572
Italy	3,148	10,193	5,650	11,300	6,435	17,423	9,990	55,944
Japan	215	6,925	204	16,075	346	10,265	53	5,120
Mexico	620	5,287	907	8,663	1,857	18,237	2,305	22,847
Sweden	14	491	99	3,240	50	1,620	[a] 535	1,674
Total	56,739	977,405	70,546	1,787,185	126,752	9,898,790	85,445	3,704,942

Country.	1900.		1901.		1902.		1903.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
United States	3,054	$197,579	2,533	$167,714	6,085	$182,108	17,110	$225,554
Austria	33,663	418,126	29,992	369,157	29,527	368,186	29,589	382,148
Canada	1,744	31,040	2,005	38,780	994	28,300	700	23,985
Ceylon	19,168	[b] 875,190	22,707	[b] 3,203,215	25,593	3,505,455	24,492	1,952,529
France	....	....	....	....	150	1,140	126	702
Germany	9,248	136,500	4,435	58,000	5,023	41,755	3,720	35,462
India	1,858	9,104	2,530	([c])	4,648	([c])	3,448	([c])
Italy	9,720	55,720	10,313	59,211	9,210	35,934	7,920	28,855
Japan	94	12,215	88	8,930	97	9,876	114	10,950
Mexico	2,561	25,650	1,473	7,385	580	3,176	1,952	42,985
Sweden	84	3,186	56	1,900	63	1,900	25	988
Total	81,194	1,764,310	76,226	[d] 3,930,359	81,970	4,177,830	89,196	2,704,158

[a] Includes crude.
[b] These values were taken from the official yearbooks of the United Kingdom.
[c] Statistics not available.
[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 of this mineral in the United States continues to be entirely from California, and during 1904 the quantity of output was 2,850 tons crude, valued at $9,298. With the exception of 51 tons from Fresno and Napa counties, this was all derived from the deposits at Portersville, Tulare County. For 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 1904, inclusive:

Quantity and value of crude magnesite produced in the United States, 1891–1904.

[Short tons.]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
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	1904	2,850	9,298

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 demand for both crude and calcined magnesite is limited on the Pacific coast, and the prohibiting freight rates have thus far prevented shipments to the east of the Missouri River. Oregon and California consume what is now being produced in the latter State, the crude being used by the manufacturers of carbonic-acid gas and the calcined product by the paper mills.

IMPORTS.

The imports of magnesite into the United States for 1903 and 1904 were as follows:

Imports of magnesite into the United States in 1903 and 1904.

[Pounds.]

	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
Magnesia:				
Calcined, medicinal	34,586	$5,412	15,546	$3,190
Carbonate of, medicinal	10,569	765	15,598	1,089
Sulphate of, or Epsom salts	2,392,831	11,326	4,085,847	18,957
Magnesite:				
Calcined, not purified	73,534,690	311,396	47,143,094	203,816
Crude	36,017,637	150,002	30,265,178	83,012

In addition, magnesium not made up into articles was imported to the value of $7,294 in 1903, and to the value of $12,190 in 1904.

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, though less is now being imported than formerly. 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 magnesite bricks made in this country come from the Fayette Manufacturing Company, of Layton, Pa., and the Harbison-Walker Refractories Company, Pittsburg, Pa. Up to this time no magnesite bricks have been made in California, notwithstanding that the crude material is so abundant; but during 1905 a factory to manufacture them has been established at Oakland, Cal., on the shore of San Francisco Bay.

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 1 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 compresser 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, barrooms, 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; in the Ural Mountains in Russia; in Quebec, Canada; in India; in the Barberton district, Transvaal, South Africa; and near the district of Lourenço Marquez, Africa. Magnesite occurs in the United States in Massachusetts, Maryland, Pennsylvania, and California, but only in the last State have the deposits been commercially utilized. The principal producing point in California is still in the vicinity of Portersville, Tulare County, though a small quantity comes from Chiles Valley and Pope Valley, Napa County, and from near Sanger, in Fresno County.

CALIFORNIA.

In California the following occurrences may be noted: In Alameda County, the King magnesite mine is about 22 miles southeast of Livermore, on the Arroyo Mocha road. No product has been hauled out to market. There is also a small undeveloped deposit 24 miles southeast of Livermore, on the Arroyo Mocha Canyon. In Mendocino County, the Vassar claim is 12 miles north of Cloverdale, near the line of the California-Northwestern Railway. This is as yet undeveloped. Napa County has several occurrences. The Mathai mines, North and South, are owned by Mr. Frank Mathai, of Chiles, and have been worked to a small extent within a few years past. The mining was done by means of open cuts. The North mine is in Soda Creek Canyon, and the South in Greasy Camp Creek. The Prest mine in Chiles Valley, 13 miles from Rutherford, has been opened at several places but has been idle five or six years. The deposit owned by Mr. E. T. Russell, of Chiles, 15 miles from Rutherford, has produced a small quantity, but is idle. The Snowflake, 11 miles from Rutherford, was worked for about twelve years and was very productive during that period, yielding, in fact, nearly all the magnesite produced in the State. The workings are quite extensive and mainly in the form of tunnels. The occurrence is in a series of ledges in a serpentine formation. The mine is at present idle. The Stanley and Bartlett mines, 12 miles from Rutherford, are on the property of the Phelan estate, and were productive for some ten years, though they are now idle. The White Rock mine, 15 miles from Rutherford, is owned by Mr. J. B. Duval, of Lidell, and the Western Carbonic Acid Gas Company, of San Francisco. The deposit was opened in 1894 and continued to produce for five years. This, like the Fairweather claim adjoining, is now unproductive. The deposit owned by Mr. J. C. Sullenger, of Oakville, Napa County, is in Pope Valley, 20 miles by road from Rutherford, but has not produced for several years.

In Placer County there are extensive undeveloped deposits in the mountainous regions about Damascus, on the Forest Hill divide. They are too far from a railroad and in too rough a country to be at present of much value. There is also an undeveloped deposit near Walkers Pass, Kern County. Near Winchester, in Riverside County, the Fireproof Mining and Milling and Manufacturing Company has secured 323 acres of land on which magnesite deposits have been found. The deposits are as yet undeveloped.

The most recent developments of interest in the magnesite industry of California are those taking place in the properties of the American Magnesite Company, at Red Mountain. Of the 27 claims of the company 19 are on Red Mountain on the Santa Clara County side, 5 in Stanislaus County, and 8 on Cedar Mountain, in Alameda County. The mines are 32 miles southeast of Livermore, at an elevation of 3,350 feet. The magnesite occurs in bold outcrops. One of the mines is being opened by a tunnel and upraise into an open quarry. The ore is to be hauled by traction engine to Livermore and thence shipped by rail to Oakland, where the manufacturing plants have been erected. Building material, brick, and carbonic-acid gas are to be manufactured. No production was made by this company in 1904, but by the latter part of 1905 the mines and factories are expected to be in full operation. The A. F. Cochrane mine, near Madrone, in Santa Clara County, is idle, not having been worked since 1897. The Weber Ranch deposit, in the same county, is on the west side of San Felipe Creek Valley, and is owned by the Bay Cities Water Company. Some little development has been done, but the mine is now unproductive.

Sonoma County has numerous deposits of this mineral. The Creon mine, 4 miles northeast of Cloverdale, is owned by Mr. J. Kolling, of San Francisco, and has been opened in three places, but is not now being worked. The Cummings deposit, 2½ miles from Cloverdale, is operated by the Sotoyome Magnesite Company, of Healdsburg, Mr. Thomas Merchant, manager. Operations on the mine were not commenced until the summer of 1905. The Eckert ranch deposit is 2 miles southeast of Cloverdale. The deposit owned by Mr. George Madeira, of Healdsburg, is 11 miles from that place, but is as yet undeveloped. The Sotoyome Magnesite Company owns a deposit on the Norton ranch, on Dry Creek, 10 miles northwest of Healdsburg, but it is not productive.

Extensive deposits occur 3 miles northeast of Portersville, Tulare County, on the first range of foothills, and it is from these that nearly all the magnesite produced in the United States has come for the last few years. Part of the magnesite mined is carried by chute and tramway to the kiln and shipped as magnesium oxide, and part is hauled by wagon to Portersville and shipped as magnesite. The deposits are worked by open cuts and tunnels. The mines are well developed, and Mr. W. P. Bartlett, the manager, states that he could ship readily two or three times as much as he does annually if the consumption warranted it. A considerable portion of the output is shipped to the Western Carbonic Acid Gas Company, of San Francisco, where it is calcined and the gas utilized commercially. Kilns for calcining the magnesite have been erected at Portersville and began operations in 1905. The calcined material is shipped to the paper mills of California and Oregon. These deposits have the advantage of being very near the line of a transcontinental road. Those which lie at a distance from railroads where long team hauls are necessary will naturally be the last to be developed. An exception to this, however, may be noted in the case of the American Magnesite Company mines, from which there is a 32-mile haul to rail. The deposits lie in 3 counties, each of which was anxious for the business of the company. This caused the supervisors of Alameda County to build an exellent road from the mountains to Livermore, and over this the ore is hauled by traction engine to the railroad station. Considerable capital has been invested in the mines and manufacturing plants, and the company expects to be able to overcome the disadvantages of the exceptionally long haul from mines to works. Generally speaking, however, the properties nearest the railroads have a distinct advantage, where the market is so limited and the prices received from the product are none too high.

MICA.

By Joseph Hyde Pratt.

INTRODUCTION.

Although mica occurs widely distributed throughout the United States and has been found in commercial sizes in about one-third of the States and Territories, it has been mined during the past year only in the following States: California, Colorado, Connecticut, Georgia, Idaho, North Carolina, New Hampshire, New Mexico, and South Dakota. In previous years mica has also been mined in Alabama, Arizona, Maine, Missouri, Nevada, New York, Rhode Island, Virginia, and Wyoming, but there was no record of any production from any of these States during 1904. In some of them there are good deposits of mica known that are not available on account of their distance from railroad transportation. This is especially true of the deposits in Arizona, Nevada, New Mexico, and Wyoming.

There are many accessory minerals found associated with the mica, some of which are of economic importance and have been valuable by-products when the mica deposits were near the markets for these other minerals. The mica deposits in the Eastern States are more favorably situated for utilizing these associated minerals than those in the West, and it is also true that the mica deposits of the Eastern States can be worked more profitably than those in the West on account of the mines being so much closer to the points of consumption of the mica.

There are a number of minerals that belong to the mica group, only a few, however, being of commercial value, namely, muscovite, phlogopite, and lepidolite. The last of these three minerals is only mined for its lithia content, and is not used for any of the purposes of a commercial mica. The other two micas, muscovite and phlogopite, include all the commercial mica that is on the market. In the United States it is only the muscovite mica that is mined, as there are at the present time no known commercial deposits of phlogopite in this country. In Canada, on the other hand, the chief mica deposits are of the phlogopite variety, with smaller deposits of muscovite.

Muscovite mica is chemically a hydrous potassium aluminum silicate, and is classified as potash mica. It is usually transparent and colorless, constituting most of the white mica on the market. Occasionally it is of a rum to ruby color. Frequently there are other minerals inclosed by the mica, sometimes crystallizing in finely divided films between the foliæ of the mica, as magnetite, flattened garnet, quartz, and tourmaline crystals, and these sometimes ruin the blocks of mica completely as a source of sheet mica.

Phlogopite mica, which is also known as magnesia mica, is a hydrous magnesium aluminum silicate, containing also some potash and soda. It is usually of a rather even color, which varies from a yellowish brown to brownish red with often something of a copper-light reflection. Occasionally it assumes a nearly black color. A considerable part of the amber mica on the market is the phlogopite variety, and Canada furnishes the chief supply.

Another mica that is commonly associated with muscovite in many pegmatitic dikes is biotite, an iron magnesia mica similar in composition to the phlogopite, but having a large part of the magnesia replaced by iron. It is much darker in color than the phlogopite, being nearly black, and does not occur in as large crystals.

The commercial value of muscovite and phlogopite is due to the very high development of the basal cleavage which permits of the splitting up of the crystals and blocks of mica into sheets of one-thirty-second or one-sixteenth of an inch in thickness as used commercially, but the cleavage can be continued perfectly up to at least one one-thousandth of an inch.

OCCURRENCE.

The muscovite represents the most common mica and is very widely distributed, being a component of many of the crystalline and sedimentary rocks. In many of these it occurs in but small scales or crystals which have no commercial value. When, however, it occurs in blocks or masses which can be split into sheets an inch or more in diameter, it has a commercial value which increases with the sizes of the cut sheets, and these vary from 1 by 1 to 8 by 10 inches. These commercial deposits of mica are found for the most part in pegmatitic dikes or veins, which occur as intrusives in granite and in hornblende and mica gneisses and schists. These dikes or veins vary in thickness from a few inches to several hundred feet and are often very irregular, having arms or apophyses branching off from them and extending out into the country rock in many directions. Sometimes these dikes are parallel to the bedding or schistosity of the gneiss or schist, and then again they break across it at varying angles. Both of these phenomena are often observed in the same dike. In character these pegmatitic dikes are very similar to granite, and occasionally they have been designated as a "coarse granite." The principal mineral constituents of these dikes are quartz, feldspar, and muscovite mica, which occur in varying proportions. In examining these dikes it will be found that sometimes the quartz and feldspar are nearly equally distributed throughout a certain part of the vein, while in other parts sometimes one and again the other will predominate. Feldspar has been observed that has crystallized out in enormous masses of more than a ton in weight, and in one instance, the Irby mine, near Spruce Pine, Mitchell County, N. C., a well-developed crystal of feldspar was observed that measured 3 by 11½ feet. Occasionally feldspar, quartz, and mica have separated out in rather small masses, giving the vein the appearance of containing an equal quantity of each. In such cases the three minerals are so intimately associated with each other that the mica is of little or no commercial value and the feldspar is also of no commercial value. Judging from observations made at a great many mica mines, the pegmatitic dikes that yield the best commercial mica are those in which the three minerals have had a tendency to crystallize out in large masses. Thus, where feldspar and quartz are in small crystals or fragments, the mica is also apt to be small. Those dikes that are two feet or less in width very seldom contain mica having any commercial value beyond what could be obtained for it as scrap mica, and hence little or no attention should be paid to such dikes as a source of mica. Not all of the wide dikes carry mica of the right quality or in sufficient quantity to afford profitable mining, for in some the mica has been observed to occur in such small crystals and blocks that no sheets could be obtained over an inch or two in diameter.

The muscovite mica occurs in these dikes usually in rough crystals (called blocks or books), which are sometimes distributed nearly evenly throughout the dike and at other times nearer the contact of the dike with the country rock. These blocks of mica are occasionally nearly perfect in their crystalline form, which is monoclinic, but imitating rhombic or hexagonal symmetry. The commercial blocks of mica usually vary in thickness from 6 to 18 inches and from 3 to 15 inches in diameter, although some blocks have been found as much as 4 feet in diameter and from 2½ to 3 feet in thickness. All of the large blocks of mica are not of sufficient quality to cut into sheets as large as would be expected from the size of the crystal, on account of much of the mica having been converted into what is called "ruled mica," the mica being divided into narrow strips whose edges are parallel to the intersection of the prism and base edges of the crystal, or into "A" mica, in which the sheets are cut or striated parallel to two adjacent edges.

There is considerable variation to be noted in the percentage of mica that occurs in these dikes and in different parts of the same dike. It is usually found, however, that in any considerable distance in the same dike the mica will average for that distance approximately the same per cent. It is seldom that the mica in a dike will average over 10 per cent of the contents of the dike for any considerable distance, and it will sometimes average as low as 1 per cent. Portions of certain dikes have been observed that had the appearance of containing a very large percentage of mica on account of a number of blocks of mica being clustered together in bunches almost touching one another, while in other portions of the same dike there would be almost a complete absence of mica for a distance of from 5 to 20 feet; but even in such a dike the general average of the mica to the other minerals corresponded to about 10 per cent. The general limits of the percentage of mica in various dikes is probably therefore from 1 to 10 per cent. It will be observed from what has been said that in mining mica there must necessarily be a very large amount of waste rock or gangue removed, and, as in nearly all mica mining it is necessary to operate by blasting, it makes the cost of production of the crude mica somewhat expensive. Hence, if any of the other minerals that must be removed in mining can be utilized commercially, they will make valuable by-products and will help to pay the cost of mining the mica. There are certain minerals associated with the muscovite mica in these veins that are of commercial value and that are discussed later under associated minerals.

On account of the irregularity of the occurrence of the blocks or books of mica in the vein nothing is known of their position by the miner unless he has exposed one or more by previous blasting, and it often happens that in drilling the drill will pass right through one of these blocks of mica, often ruining some very large sheets. Though this may sometimes become apparent by the material that is taken out of the drill hole, still the miner would be unable to determine whether his drill was in contact with a good block of mica or merely with small masses, and so the only thing for him to do is to keep on with the hole he is drilling and to let the blasting reveal what kind of a block of mica he has drilled into. The percentage, however, of blocks of mica that are spoiled by drilling is very small. Occasionally after blasting the miner will find exposed in the face of his drift a half dozen or more blocks of mica, some with the face of the block exposed and others with just their edges showing. He is then able either to gad out these blocks or by means of pop holes to remove all of the blocks without injuring them. It is customary in many of the mica mines to blast out the mica and gangue by means of benches, which perhaps eliminates as far as possible the chances of ruining the good blocks of mica.

ASSOCIATED MINERALS.

As has been already stated, the three principal minerals of the pegmatitic dikes are quartz, feldspar, and muscovite mica, and these probably constitute about 95 to 99 per cent of the dike. Besides these, there are a large number of minerals that have been found in these pegmatitic dikes, some occurring sparingly and others occurring abundantly. Some of these minerals have a commercial value, such as feldspar, quartz, and those that can be used as gems. There is given below a list of those minerals that are known to have been found in pegmatitic dikes of the United States, and those which have been obtained in sufficient quantity to be of value commercially are marked with an asterisk.

List of minerals found in the pegmatitic dikes of the United States.

Quartz* (massive, crystallized, and smoky).
Feldspars:
Albite.*
Oligoclase.*
Orthoclase.*
Microline.*
Kaolin.*
Micas:
Muscovite.*
Biotite.
Lepidolite.*
Garnets:
Almandite.
Pyrope.
Andradite.
Spessartite.
Beryl* (emerald, yellow, blue, aquamarine).
Tourmaline* (blue, red, green, and other gem varieties; black).
Enstatite.
Actinolite.
Spodumene* (varieties, ordinary,* hiddenite,* and kunzite*).
Eucryptite.
Iolite.
Topaz.
Cyanite.
Zoisite (variety, Thulite).
Epidote.
Helvite.
Phenacite.
Zircon.*
Pyrophyllite.
Chabazite.
Pollucite.*
Chrysoberyl.
Titanite (Sphene).
Allanite.
Gadolinite.*
Yttrialite.
Nivenite.
Fergusonite.
Microlite.
Columbite.*
Tantalite.*
Samarskite.*
Rogersite.
Hatchettolite.
Magnetite.
Hematite.
Menaccanite (Ilmenite).
Corundum.
Rutile.
Brookite.
Cassiterite.*
Limonite.
Opal (variety, Hyalite).
Pyrite.
Molybdenite.
Pyrrhotite.
Fluorite.
Uraninite.*
Gummite.*
Autunite.
Uranotil.
Phosphuranytile.
Monazite.
Xenotime.
Apatite.
Triphylite.
Lithiophilite.
Amblygonite.*
Beryllonite.

List of minerals found in the pegmatitic dikes of the United States—Continued.

Herderite.	Fairfieldite.
Triploidite.	Hamlinite.
Natrophilite.	Malachite.
Childrenite.	Rhodochrosite.
Eosphorite.	Graphite.
Dickinsonite.	

The majority of these minerals are found very rarely in the pegmatitic dikes, and some of them have been found at only one locality. Others are found frequently throughout many of the pegmatitic dikes, although some dikes have been observed that contained no other minerals besides feldspar, quartz, and mica. Of these associated minerals the common accessory minerals are beryl, some one of the garnets, tourmaline, and apatite. Magnetite is a mineral very commonly associated with mica, and it occurs as small films of mineral crystallizing out between the folia of the mica. In certain localities, as in many of the mica mines of Mitchell County, N. C., the uranium minerals, uraninite, gummite, etc., are quite common.

A number of these accessory minerals that have been found in commercial quantity are gem minerals, as beryl, tourmaline, hiddenite, kunzite, etc.

PERCENTAGE OF MICA IN THE DIKES.

As has been stated, the percentage of mica in these pegmatitic dikes varies from 1 to 10 per cent, and there is probably an average of not over from 10 to 15 per cent of the mica that is mined that can be cut into sheet mica, the rest being waste or scrap mica. Selected masses or blocks of the mica mined may average from 30 to 40 per cent and occasionally as high as 75 per cent of sheet mica. On the other hand, there will be certain portions of the dike in which none of the mica mined can be cut into sheets. Such variations may take place within the space of a few feet. In some of the mines in the western part of the United States, as in California and New Mexico, there is hardly a 2 to 3 per cent yield of cut or sheet mica. The North Carolina mines will probably average the highest percentage of cut mica.

There are a number of reasons for this large percentage of waste mica—the irregularity of the blocks of mica and of the individual sheets; the ruled mica and the "A" mica, which reduce the sizes of sheets that can be cut or prevent entirely any sheets being cut from the block; the mica may be specked or stained, or may contain a great deal of magnetite in thin crystallized films between the foliæ of the mica; and many blocks of mica may be destroyed by having garnet, tourmaline, or quartz crystallized out between the folia.

USES.

Formerly the chief and almost the only use of mica was for cutting into sheets of varying sizes, which were used for stoves; the very small sizes and all the very small pieces of the waste obtained in mining and in cutting the sheets were thrown away. Now, however, there is a very large demand for mica for electrical purposes, and this has resulted in the utilization of a great quantity of the small pieces of mica that were first thrown away and were then used as scrap mica, which was ground. These pieces are now cut by machinery into small circular disks (1 inch in diameter), and rectangular pieces ($\frac{3}{4}$ by 2 inches), which are used for insulation purposes in electrical apparatus. Larger sheets of mica are also used for electrical purposes, but it has been found that a large sheet can be built up from small ones, which will give as satisfactory results as the single large sheet, and are, of course, not so expensive. The use of the sheets of clear, white mica for stoves has decreased very rapidly during the last ten years, and there is not now the demand for as many of the larger sheets as there was formerly, although the decrease in the demand for use in stoves has been somewhat balanced by the demand for the sheets for the manufacture of chimneys for incandescent lights and for use in the manufacture of many novelties.

The large percentage of scrap mica, which constitutes from 75 to 90 per cent of the mica mined and which was formerly all thrown away, is now utilized principally in the form of ground mica. This ground mica, which is separated into different sizes and grades, is now being utilized for a great variety of purposes. The coarser grades are used in the manufacture of fireproof materials, principally paint, and for the packing of steam pipes, boilers, etc., to prevent radiation of heat, as mica is a very good nonconductor. In the manufacture of lubricating materials, the mica must be ground to a still finer degree; and the very finest product is used in the manufacture of certain kinds of wall papers, for other decorative purposes, and in the manufacture of paints.

PRODUCTION.

During 1904 the production of mica was confined to the following States, given in the order of the importance of production: North Carolina, New Hampshire, Colorado, New Mexico, California, Georgia, South Dakota, Connecticut, and Idaho.

The total quantity of sheet or plate mica produced in the United States during 1904 as reported to the Survey was 668,358 pounds, valued at $109,462, an increase of 48,758 pounds in quantity but a decrease of $8,626 in value, as compared with a production of 619,600 pounds, valued at $118,088, in 1903. The reports of sheet or plate mica for 1900, 1901, and 1902 were 456,283, 360,060, and 373,266 pounds, respectively. It appears that in 1903 and 1904 the production was nearly 300,000 pounds greater than in 1901 and 1902. This large increase in the production of sheet mica during the last two years is due to the very large quantity of the small-sized disks and rectangular sheets of mica that have been prepared for electrical purposes.

The production of scrap mica during 1904 amounted to 1,096 short tons, valued at $10,854, as against 695 short tons, valued at $6,460, in 1903. During 1903, however, there were also reported 964 short tons, valued at $18,580, which were sold in the rough blocks as produced. This probably made at least 800 tons of scrap mica, so that the actual production of scrap mica in 1903 was greater than that in 1904. Of the 1904 production 610,121 pounds of sheet mica, valued at $100,724, and 200 short tons of scrap mica, value at $2,000, were produced in North Carolina. This was over nine-tenths of the total production of the United States in 1904.

In the following table is shown the annual production of mica in the United States since 1880:

Annual production of mica, 1880–1904.

Year.	Quantity.	Value.
	Pounds.	
1880	81,669	$127,825
1881	100,000	250,000
1882	100,000	250,000
1883	114,000	285,000
1884	147,410	368,525
1885	92,000	161,000
1886	40,000	70,000
1887	70,000	142,250
1888	48,000	70,000
1889	49,500	50,000
1890	60,000	75,000
1891	75,000	100,000
1892	75,000	100,000
1893 Sheet	51,111	88,929
1893 Scrap	a 156	
1894 Sheet	35,943	52,388
1894 Scrap	a 191	
1895 Sheet	44,325	55,831
1895 Scrap	a 148	
1896 Sheet	49,156	65,441
1896 Scrap	a 222	1,750
1897 Sheet	82,676	$80,774
1897 Scrap	a 740	14,452
1898 Sheet	129,520	103,534
1898 Scrap	a 3,999	27,564
1899 Sheet	108,570	70,587
1899 Scrap	a 1,505	50,878
1900 Sheet	456,283	92,758
1900 Scrap	a 5,497	55,202
1901 Sheet	360,060	98,859
1901 Scrap	a 2,171	19,719
1902 Sheet	373,266	83,843
1902 Scrap	a 1,028	13,081
1902 Rough as mined, or unmanufactured	a 372	21,925
1903 Sheet	619,600	118,088
1903 Scrap	a 695	6,460
1903 Rough as mined, or unmanufactured	a 964	18,580
1904 Sheet	668,358	109,462
1904 Scrap	a 1,096	10,854

a Short tons.

When this table of production is compared with that of the imports, it will be seen that of late years the latter have been several times greater than the home production. This is partly due to the fact that mica from Canada and India, which can be entered at a low valuation, has a tendency to curtail the production of mica in the United States. This is perhaps especially true of that imported from India, which can be mined and landed in this country at a lower price than, in some cases, mica can be mined in the United States. The uncertainty of the occurrence of mica in the veins and the expense of mining will account to some extent for the relatively small production of mica in the United States, where there are large deposits known; and, furthermore, a large number of small producers are entirely dependent upon one small mine, and when the mica in this begins to give out or becomes poor, they have not the means to carry on much dead work and have no other deposit to help fill out this deficiency. It is very possible, therefore, that a consolidation of a number of the mica properties in different sections might be profitable and might become a means of increasing the production.

IMPORTS.

There is annually imported into the United States several times the quantity of domestic production of sheet mica, the imports coming principally from India and Canada. In the following table is given the value of mica imported into the United States from 1869 to 1896:

Value of unmanufactured mica imported and entered for consumption in the United States, 1869–1896.

Year ending—	Value.	Year ending—	Value.	Year ending—	Value.
June 30—		June 30—		Dec. 1—	
1869	$1,165	1879	$9,274	1888	a $57,541
1870	226	1880	12,562	1889	a 97,351
1871	1,460	1881	5,839	1890	a 207,375
1872	1,002	1882	5,175	1891	95,242
1873	498	1883	9,884	1892	218,938
1874	1,204	1884	28,284	1893	147,927
1875	....	1885	28,685	1894	126,184
1876	569	Dec. 31—		1895	174,886
1877	13,085	1886	a 56,354	1896	169,085
1878	7,930	1887	a 49,085		

a Including mica waste.

Under the new classification made necessary by the Dingley tariff act, in effect from and after July 24, 1897, mica is designated as "unmanufactured" and "cut or trimmed." A specific import duty of 6 cents per pound is imposed upon the former and 12 cents per pound upon the latter, with an additional 20 per cent ad valorem duty on each.

The imports, since the new classification took effect, for the years 1898, 1899, 1900, 1901, 1902, 1903, and 1904, have been mainly as "unmanufactured" mica, as follows:

Mica imported and entered for consumption in the United States, 1898–1904.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
1898.	*Pounds.*		1902.	*Pounds.*	
Unmanufactured	877,930	$115,930	Unmanufactured	2,149,557	$419,362
Cut or trimmed	78,567	34,152	Cut or trimmed	102,299	46,970
Total	956,497	150,082	Total	2,251,856	466,332
1899.			1903.		
Unmanufactured	1,709,839	233,446	Unmanufactured	1,355,375	288,783
Cut or trimmed	67,293	42,538	Cut or trimmed	67,680	29,186
Total	1,777,132	275,984	Total	1,423,055	317,969
1900.			1904.		
Unmanufactured	1,892,000	290,872	Unmanufactured	1,085,343	241,051
Cut or trimmed	64,391	28,688	Cut or trimmed	61,986	22,663
Total	1,956,391	319,560	Total	1,147,329	263,714
1901.					
Unmanufactured	1,598,722	299,065			
Cut or trimmed	78,843	35,989			
Total	1,677,565	335,054			

MINERAL WATERS.

PRODUCTION.

In all the geographic sections into which the United States has been divided, with the exception of the South Atlantic section, there is a decided increase in the number of gallons of mineral waters sold in 1904; and in only two sections—namely, the North Atlantic and the South Atlantic—has there been a decrease in the value of the product sold, and this decrease is comparatively small. The list for 1904 includes a total of 738 springs, which is a gain of 13 over the list of 1903. Thirty-four springs have been added to the list of 1903, and 21 have been dropped from it, all of the latter having reported that the springs have been commercially abandoned and are not likely to be utilized in the near future.

For the year 1904 the number of springs actually reporting sales is 484, which is 76 less than the number reporting in 1903. The springs not heard from number 206, and with very few exceptions all reported sales in 1903. In addition to these, 48 springs report that no sales were made in 1904. This makes the total delinquent and idle list 254. Estimates based on previous reports, mainly those made in 1903, have been added to the total of the figures given by the 484 springs whose sales are given in this report. The average price per gallon in 1904 was about 16 cents, as compared with 17 cents for 1903.

In 1904 the total production, including the figures estimated for the delinquent springs, is 67,718,500 gallons, with a valuation of $10,398,450. This is a gain of 16,475,743 gallons over the production of 1903, and a gain in valuation of $1,357,372. When we consider only the 484 springs which actually reported sales in 1904, the figures are 58,964,145 gallons, as compared with 40,107,147 gallons in 1903, a gain of 18,856,998 gallons; and the value of the product of 1904 for these 484 springs is $9,418,873, as compared with $6,788,426 for 1903, a gain of $2,630,447.

The North Atlantic States show a loss in 1904 of 8 springs, the total being 241 instead of 249, as in 1903, 16 springs having been dropped from the list and 8 new ones added to it. Reports of sales were received from 171 springs, leaving a delinquent list of 70. The total number of gallons sold in 1904 in this section is reported as 15,303,772, which is a gain of 4,105,222 gallons over the product of 1903. The valuation is $1,841,835, a loss of $610,791 as compared with the figures of 1903. The 8 springs new to the list are the following:

Maine.—Switzer Spring, Pejepscot Spring, Thorndike Mineral Spring.

New Jersey.—Red Rock Spring.

New York.—Chautauqua Lithia Spring, Solid Rock Lithia Spring, Knickerbocker Spring.

Pennsylvania.—Pocono Mineral Spring.

The South Atlantic States show a net gain of 2 springs, 3 having been added to the list and 1 dropped from it. The total for 1904 is 120, as compared with 118 in 1903. Of these, however, only 66 report sales in 1904, leaving a delinquent list of 54. The number of gallons reported as sold is 3,401,239, at a valuation of $494,159. This is a loss of 1,123,278 gallons and $277,214, as compared with the figures of 1903. The 3 springs new to the list in 1904 are the following:

North Carolina.—Haywood White Sulphur Springs.

South Carolina.—White Diamond Lithia Spring.

Virginia.—Bath Alum Springs.

In the North Central States the list shows a net gain of 11 springs for 1904, 13 new springs having been added while only 2 were dropped. The total for the section is 197, as compared with 186 in 1903. The number of gallons reported as sold in 1904 is 30,541,553, a gain of 13,397,607 gallons. The valuation of this product is $5,529,160, a gain of $3,320,948. The 13 springs new to the list are the following:

Indiana.—Rhodes Mineral Spring.

Iowa.—Red Mineral Spring.

Kansas.—Wetmore Mineral Spring.

Minnesota.—Owatonna Vichy Springs.

Missouri.—Belcher Artesian Well, Mooresville Chalybeate Spring, Glen Eden Spring.

North Dakota.—Hydatso Spring.

Ohio.—Fisher's Magnesia Mineral Spring, Sand Rock Spring, Woods Lithia Spring.

Wisconsin.—Alta Spring, Sulphur Mineral Spring.

For the South Central States there is in 1904 a net gain of 5 springs, 7 having been added to the list while 2 were dropped from it. Of the 82 springs credited to this section, 52 report sales in 1904. The production was 3,105,125 gallons, a gain of 176,116 gallons over 1903. The value of the product for 1904 is $291,142, an increase of $14,674 over the valuation of the product in 1903. The 7 springs new to the list in 1904 are the following:

Alabama.—Woodbound Spring.

Kentucky.—Lexington Lithia Spring.

Mississippi.—Rawls Springs.

Oklahoma.—Lewis Crystalline Lithia Wells.

Texas.—Congress Well, Lone Star Spring, Texarkana Springs.

For the Western States and Territories, there is a gain of 3 springs, the total for 1904 being 98, as compared with 95 in 1903; and of these, 66 report sales in 1904, leaving a delinquent list of 32 springs for this section. The number of gallons reported as sold in 1904 is 6,612,456, an increase of 2,301,331 gallons over 1903. The value of the product of 1904 is $1,162,577, an increase of $182,830 over 1903. The 3 springs new to the list are the following:

California.—Tia Juana Mineral Spring, Alder Glen Springs.

Oregon.—Cascade Spring.

Production of mineral waters in 1904, by States and Territories.

State or Territory.	Springs reporting sales.	Quantity.	Value.
		Gallons.	
Alabama	6	17,890	$4,340
Arizona	3	2,850	233
Arkansas	5	534,440	57,107
California	35	3,756,779	899,763
Colorado	12	780,078	120,705
Connecticut	6	279,100	37,190
Florida	3	9,500	4,140
Georgia	7	305,294	45,744
Illinois	14	15,387,800	3,038,096
Indiana	16	398,232	376,485
Iowa	3	114,000	16,700
Kansas	16	194,350	47,070
Kentucky	5	275,780	31,539
Maine	23	1,535,955	428,083
Maryland	5	416,200	44,320
Massachusetts	56	5,214,068	353,485
Michigan	19	3,385,675	118,422
Minnesota	4	902,500	21,545
Mississippi	6	332,131	60,258
Missouri	18	333,204	53,741
New Hampshire	5	721,560	182,578
New Jersey	9	188,450	24,870
New York	41	6,352,517	783,244
North Carolina	7	145,800	21,902
Ohio	13	3,223,958	306,566
Oregon	8	60,849	13,296
Pennsylvania	21	743,050	90,465
Rhode Island	4	206,072	22,570
South Carolina	5	351,485	80,415
Tennessee	13	314,717	46,049
Texas	14	1,142,500	64,923
Vermont	6	63,000	19,350
Virginia	35	2,117,420	281,998
Washington	4	24,900	10,580
West Virginia	4	55,540	15,640
Wisconsin	25	6,586,834	1,546,535
Other States[a]	8	2,489,667	148,926
Total	484	58,964,145	9,418,873
Estimate for delinquent springs 206. Springs reporting no sales 48.	254	8,754,355	979,577
Grand total	738	67,718,500	10,398,450

[a] The States in which only one spring each has made a report are included here. These States are Idaho, Indian Territory, Louisiana, Montana, New Mexico, North Dakota, Oklahoma, and Utah.

Summary of reports of mineral springs for 1904.

State or Territory.	Springs reporting sales.	Springs not reporting sales.	Total used commercially.
NORTH ATLANTIC STATES.			
Maine	23	7	30
New Hampshire	5	1	6
Vermont	6	0	6
Massachusetts	56	14	70
Rhode Island	4	0	4
Connecticut	6	9	15
New York	41	19	60
New Jersey	9	6	15
Pennsylvania	21	14	35
SOUTH ATLANTIC STATES.			
Maryland	5	3	8
District of Columbia	0	3	3
Virginia	35	24	59
West Virginia	4	7	11
North Carolina	7	6	13
South Carolina	5	6	11
Georgia	7	3	10
Florida	3	2	5
SOUTH CENTRAL STATES.			
Kentucky	5	0	5
Tennessee	13	1	14
Alabama	6	3	9
Mississippi	6	3	9
Louisiana	1	2	3
Texas	14	17	31
Arkansas	5	3	8
Oklahoma	1	1	2
Indian Territory	1	0	1
NORTH CENTRAL STATES.			
Ohio	13	12	25
Indiana	16	8	24
Illinois	14	7	21
Michigan	19	9	28
Wisconsin	25	13	38
Minnesota	4	2	6
Iowa	3	4	7
Missouri	18	8	26
North Dakota	1	0	1
South Dakota	0	2	2
Nebraska	0	1	1
Kansas	16	2	18
WESTERN STATES AND TERRITORIES.			
Wyoming	0	2	2
Montana	1	2	3
Colorado	12	7	19
New Mexico	1	6	7
Arizona	3	1	4
Utah	1	2	3
Nevada	0	1	1
Idaho	1	0	1
Oregon	8	2	10
Washington	4	0	4
California	35	9	44
Total	484	254	738

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 1904. The springs from which no reports were received are included in the estimate given at the end of the table on page 7.

ALABAMA.

The State of Alabama gains 1 spring in 1904, making a total of 9 for the year; of these the following 6 report sales:

Bailey Springs, Florence, Lauderdale County.
Healing Springs, Healing Springs, Washington County.
MacGregor Springs, Spring Hill, Mobile County.
Wilkinson's Matchless Mineral Wells, Greenville, Butler County.
Woodbound Spring, Magnolia Springs, Baldwin County.
York Aperient Springs, York, Sumter County.

ARIZONA.

The list for Arizona shows no change, 4 still being the total; of these the following 3 report sales for 1904:

Agua Caliente, Maricopa County.
Castle Creek Hot Springs, Yavapai County.
Geyser Springs or Arizona Medical Springs, Yavapai County.

ARKANSAS.

Of the 8 springs credited to Arkansas, the following 5 report sales for 1904:

Arkansas Lithia Springs, near Hope, Hempstead County.
Arsenic Springs, Hot Springs, Garland County.
Eureka Springs, Eureka Springs, Carroll County.
Mountain Valley Springs, near Hot Springs, Garland County.
Ravenden Springs, Ravenden Springs, Randolph County.

CALIFORNIA.

California gains 2 new springs, making a total of 44 for 1904; of these 35 report as follows:

Adams Springs, Lake County.
Ætna Springs, Pope Valley, Lidell, Napa County.
Alder Glen Springs, Cloverdale, Sonoma County.
Alhambra Mineral Spring, Martinez, Contra Costa County.
Allen Springs, Allen Springs, Lake County.
Bartlett Springs, Bartlett Springs, Lake County.
Blair's Mineral Spring, near Mono Lake, Mono County.
Bradley Spring, near Ramono, 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.
Isham Springs, near San Diego, San Diego 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.
Phillips Napa Springs, Chiles Valley, Napa County.
Ramona Natural Mineral Spring, Los Angeles, Los Angeles County.
Samuel Soda Springs, east of St. Helena, Napa County.
San Benito Springs, Tres Pinos, San Benito County.
Tia Juana Mineral Spring, Tia Juana, San Diego County.
Tolenas Springs, near Suisun, Solano County.
Tuscan Springs, Tuscan, Tehama County.
Upper Soda Springs, near Dunsmuir, Siskiyou County.
Veronica Springs, Santa Barbara, Santa Barbara County.
Witter Medical Spring, Witter, Lake County.

COLORADO.

The list for Colorado remains at 19; of these the following 12 report sales for 1904:

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.
Golden Lithia Spring, Golden, Jefferson County.
Navajo, Manitou, Cheyenne, and Shoshone Springs, Manitou, El Paso County.
The Dr. Horn Mineral Springs, Colorado Springs, El Paso County.
Ute Iron Springs, Manitou, El Paso County.
Yampah Spring, Glenwood Springs, Garfield County.

CONNECTICUT.

Of the 15 springs credited to Connecticut reports of sales for 1904 have been received from only 6; they are the following:

Arethusa Spring, Seymour, New Haven County.
Cherry Hill Spring, Hamden, New Haven County.
Live Oak Spring, Meriden, New Haven County.
Mohican Spring, near Bridgeport, Fairfield County.
Pequabuck Mountain Spring, Bristol, Hartford County.
Stafford Mineral Spring, Stafford Springs, Tolland County.

DISTRICT OF COLUMBIA.

Although the District of Columbia is credited with 3 springs no reports have been received from them.

FLORIDA.

There is no change in the list for Florida. Of the 5 springs credited to the State reports of sales for 1904 were received from the 3 following:

Magnolia Springs, Magnolia Springs, Clay County.
Orange City Mineral Spring, Orange City, Volusia County.
White Sulphur Springs, White Springs, Hamilton County.

GEORGIA.

The list for Georgia in 1904 remains at 10; of these the following 7 report sales:

Artesian Lithia Well, Austell, Cobb County.
Austell Lithium Springs, near Austell, Cobb County.
Bowden Lithia Springs, Lithia Springs, Douglas County.
Catoosa Springs, Catoosa County.
Daniel Mineral Spring, near Union Point, Greene County.
Hughes Mineral Springs, near Rome, Floyd 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 1904. It is the following:

Idanha Natural Lithia Spring, Soda Springs, Bannock County.

ILLINOIS.

The list for Illinois for 1904 remains at 21, and of these 14 report sales, 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.
Cumberland Mineral Spring, near Greenup, Cumberland County.
Diamond Mineral Spring, Grantfork, Madison County.
Elmhurst Mammoth Spring, Elmhurst, Dupage County.
Gravel Springs, near Jacksonville, Morgan County.
Macinac Mineral Spring, near Carlock, Woodford County.
Min-ni-Ni yan Spring, Bristol, Kendall County.
Mokena Mineral Spring, Mokena, Will County.
Original Springs, Okawville, Washington County.
Sanicula Springs, Ottawa, Lasalle County.
White Diamond, formerly Spouting Mineral Spring, South Elgin, Kane County.

INDIANA.

The list for Indiana for 1904 is increased by 1 spring, making a total of 24; of these 16 report sales. They are:

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.
Lasalle Springs, Martin County.
Lily White Sulphur Spring, Sulphur, Crawford County.
Magnetic Mineral Spring, Terre Haute, Vigo County.
Mudlavia, formerly Indiana Mineral Springs, Mudlavia, Warren County.
Mudlavia Artesian Sulphur Spring, Mudlavia, Warren County.
Paoli Lithia Spring, Paoli, Orange County.
Rhodes Mineral Springs, West Baden, Orange County.
West Baden Springs, West Baden, Orange County.
Winona Grotto Lithia Spring, Winona Lake, Kosciusko County.

INDIAN TERRITORY.

The 1 spring credited to Indian Territory reports sales for 1904. It is:

Beach Spring, Sulphur, Chickasaw Nation.

IOWA.

The list for Iowa becomes 7 for 1904, a gain of 1, and of these 3 report sales for 1904. They are the following:

Red Mineral Spring, Eddyville, Wapello County.
Boone Mineral Well, Boone, Boone County.
Fry's Colfax Mineral Springs, Colfax, Jasper County.

KANSAS.

The list for Kansas gains 1 spring for 1904, making a total of 18; of these the following 16 report sales:

Abilene Mineral Wells, Willowdale Township, Dickinson County.
Blasing's Natural Medical Spring, Manhattan, Riley 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.
Wetmore Mineral Spring, Wetmore, Nemaha County.

KENTUCKY.

There is a net loss of 1 in the list for Kentucky, 1 spring being added and 2 being dropped. Of the 5 springs credited to the State, all report sales for 1904:

Anita Spring, Lagrange, Oldham County.
Bluelick Springs, Bluelick Springs, Nicholas County.
Crab Orchard Springs, Crab Orchard, Lincoln County.
Hamby Salts, Iron, and Lithia Well, Dawson Springs, Hopkins County.
Lexington Lithia, Lexington, Fayette County.

LOUISIANA.

Of the 3 springs credited to Louisiana, 1 only reports for 1904, as follows:

Ozone Spring, Pearl River, St. Tammany Parish.

MAINE.

The list for Maine makes a net gain of 2 springs, 3 having been added to the list of 1903 and 1 dropped from it. The total for 1904 is 30, and of these 23 report sales, as follows:

Carrabasset Spring, Jerusalem Township, Franklin County.
Cold Bowling Spring, Steep Falls, Limington, York County.
Crystal Mineral Springs, Auburn, Androscoggin County.
Glenrock Mineral Spring, Green, Androscoggin 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.
Pejepscot Mineral Spring, Auburn, Androscoggin County.
Pownal Spring, West Pownal, Cumberland County.
Poland Spring, Poland, Androscoggin County.
Rocky Hill Spring, Fairfield, Somerset County.
Seal Rock Springs, Saco, York County.
Switzer Spring, Prospect, Penobscot County.
Thorndike Mineral Spring, Thorndike, Waldo County.
Ticonic Mineral Spring, Winslow, Kennebec County.
Underwood Spring, Falmouth Foreside, Cumberland County.
Wawa Lithia Spring, Ogunquit, Wells, York County.
Wilson Spring, North Raymond, Cumberland County.

MARYLAND.

Maryland loses 1 spring from the list of 1903, leaving a total of 8 for 1904. Of these 5 reported sales, as follows:

Carroll Springs, Forest Glen, Montgomery County.
Chattolanee Springs, Chattolanee, Baltimore County.
Mardela Mineral Spring, Mardela, Wicomico County.
Rock Hill Indian Spring, Rockville, Montgomery County.
Roland Park Artesian Well, Roland Park, Baltimore County.

MASSACHUSETTS.

Massachusetts loses 5 springs from the list of 1903, leaving a total of 70 for 1904. Of these 56 report sales. They are the following:

Arctic Polar Spring, Spencer, Worcester County.
Ballardvale Lithia Spring, Andover, Essex 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.
Chapman's Crystal Mineral Spring, Stoneham, Middlesex 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.
Granite Rock Spring, Brockton, Plymouth County.
Highland Spring, North Abington, Plymouth County.
Howe Spring, Millbury, Worcester 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.
Massasoit Spring, West Springfield, Hampden County.
Milton Spring, Milton, Norfolk County.
Monatiquot Spring, South Braintree, Norfolk County.
Moose Hill Spring, Swampscott, Essex County.
Mount Holyoke Lithia Spring, South Hadley, Hampshire County.
Mount Orient Spring, Pelham, Hampshire County.
Mount Pleasant Spring, Lowell, Middlesex County.
Mount Washington Cold Spring, Chelsea, Suffolk County.
Myles Standish Spring, South Duxbury, Plymouth County.

Nemasket Springs, Middleboro, Plymouth County.
Nobscot Mountain Spring, Framingham, Middlesex County.
Norwood Spring, Norwood, Norfolk County.
Pepperell Mineral Spring, Pepperell, Middlesex County.
Purity Spring, Spencer, Worcester County.
Ravenwood Spring, Gloucester, Essex County.
Robbin's Spring, Arlington Heights, Middlesex County.
Sager Spring, Danvers, Essex County.
Shawmut Spring, West Quincy, Norfolk County.
Silver Seal Spring, Woburn, Middlesex County.
Simpson Spring, South Easton, Bristol County.
Smiley Spring, Haverhill, Essex 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.
Wilbraham Mountain Spring, Wilbraham, Hampden County.

MICHIGAN.

Michigan loses 1 spring from the list of 1903, leaving a total of 28 for 1904. Of these 19 report sales as follows:

Andrews Magnetic Mineral Springs, St. Louis, Gratiot County.
Bromo-Hygeia Mineral Well, Coldwater, Branch County.
Cooper Farm Spring, Birmingham, Oakland County.
Eastman Mineral Springs, Benton Harbor, Berrien County.
Midland Mineral Springs, Midland City, Midland County.
Mount Clemens Sprudel Water, Mount Clemens, Macomb County.
No-che-mo Mineral Spring, Reed City, Osceola County.
Original Mount Clemens Mineral Spring, Mount Clemens, Macomb County.
Pagoda Spring, Mount Clemens, Macomb County.
Premier (formerly Excelsior) Mineral Springs, Benton Harbor, Berrien County.
Plymouth Rock Well, Plymouth, Wayne County.
Ponce de Leon Springs, Paris Township, Kent County.
Prosit Flowing Well, Oak Grove, Flint, Genesee County.
Red Cross Mineral Well, Big Rapids, Macosta County.
Salutaris Spring, St. Clair Springs, St. Clair County.
Sanitas Spring, Topinabee, Cheboygan County.
Victory Springs, Mount Clemens, Macomb County.
Welcome Island Lithia Springs, near Pontiac, Oakland County.
Wurtzel's Mineral Spring, Thomastown, near Frost, Saginaw County.

MINNESOTA.

Minnesota gains 1 spring, making a total of 6 for 1904. Of these the following 4 report sales:

Indian Medical Spring, Elk River, Sherburne County.
Mankato Mineral Springs, near Mankato, Blue Earth County.
Owatonna Vichy Springs, Owatonna, Steele County.
Trio Siloam Springs, Austin, Mower County.

MISSISSIPPI.

The list for Mississippi gains 1 spring for 1904, making a total of 9. Of these, 6 report sales, as follows:

Arundel Lithia Springs, near Meridian, Lauderdale County.
Browns Wells, Browns Wells, Copiah County.
Castalian Springs, near Durant, Holmes County.
Rawls Spring, near Hattiesburg, Perry County.
Stafford Mineral Springs, near Vosburg, Jasper County.
Tallaha Springs, near Charleston, Tallahatchie County.

MISSOURI.

The list for Missouri gains 3 springs, making a total of 26 for 1904. Of these, 18 report sales, as follows:

Aqua Vitæ Gusher Spring, Canton, Lewis County.
B. B. Mineral Springs, Bowling Green, Pike County.
Belcher Artesian Well, St. Louis.
Blue Lick Springs, Blue Lick, Saline County.
Chalybeate Springs, Mooresville, Livingston County.
Crystal Lithium Spring, Excelsior Springs, Clay County.
Cusenbury Spring, near Kansas City, Jackson County.
Eldorado Springs, Eldorado Springs, Cedar County.
Glen Eden Spring, Glasgow, Howard 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.
Montesano Springs, Jefferson County.
Sweet Springs, Sweet Springs, Saline County.

MONTANA.

Of the 3 springs credited to Montana, only 1 reports sales for 1904. It is the following:

Lissner's Mineral Springs, Helena, Lewis and Clarke County.

NEBRASKA.

No report of sales for 1904 has been received from the 1 spring credited to Nebraska.

NEVADA.

No report of sales for 1904 has been received from the 1 spring on the list for Nevada.

NEW HAMPSHIRE.

The list for New Hampshire remains the same as in 1903, the total being 6. Of these the following 5 report sales for 1904:

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.

The list for New Jersey is increased by 1 spring, making a total of 15 for 1904, and of these only 9 report sales. They are the following:

Alpha Spring, Springfield, Union County.
Beacon Mountain Spring, Denville, Morris County.
Hatawanna Spring, Buddlake, Morris County.
Indian Kalium Spring, Gloucester, Camden County.
Kalium Springs, Collingswood, Camden County.
Oakland Vernam Spring, near Oakland, Bergen County.
Red Rock Spring, Spring Valley Road, Bergen County.
Washington Rock Spring, Warrenville, Somerset County.
Watchung Spring, Plainfield, Union County.

NEW MEXICO.

Of the 7 springs credited to New Mexico only 1 reports sales for 1904. It is the following:

Artesian Coyote Mineral Spring, Coyote Canyon, Bernalillo County.

NEW YORK.

There is a net loss for the State of New York of 2 springs, 3 having been added to the list of 1903 and 5 taken from it. The total for 1904 is 60, and of these 41 report sales. They are the following:

Avon Sulphur Springs, Avon, Livingston County.
Ayers Amherst Mineral Springs, near Williamsville, Erie County.
Baldwin Cayuga Mineral Springs, Cayuga, Cayuga County.
Breesport Oxygenated Mineral Springs, Breesport, Chemung County.
Chautauqua Lithia Spring, Westfield, Chautauqua County.
Chemung Spring, Chemung, Chemung County.
Clyde Mineral Spring, Clyde, Wayne County.
Deep Rock Spring, Oswego, Oswego County.
Geneva Lithia Mineral Water Spring, Geneva, Ontario County.
Geneva Red Cross Lithia 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.
Knickerbocker Spring, Fishkill, Dutchess County.
Lithia Polaris Spring, near Boonville, Oneida County.

Massena Spring, Massena Springs, St. Lawrence County.
Mount View Spring, near Poughkeepsie, Dutchess 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.
- Excelsior Spring.
- Geyser Spring.
- Hathorn Spring.
- High Rock Spring.
- Lincoln Spring.
- Patterson Mineral Spring.
- Quevic Spring.
- Saratoga Arondack (formerly Kissingen) Spring.
- Saratoga Carlsbad Spring.
- Saratoga Seltzer Spring.
- Saratoga Star Spring.
- Saratoga Vichy Spring.
- Saratoga Victoria Spring.

Solid Rock Lithia Spring, Franklin Springs, Oneida County.
Split Rock Spring, Franklin Springs, Oneida County.
The Vita Spring, Fort Edward, Washington County.
Verona Mineral Springs, Verona, Oneida County.
Washington Lithia Spring, Ballston Spa, Saratoga County.

NORTH CAROLINA.

North Carolina's list gains 1 spring, making a total of 13 for 1904. Of these 7 report sales as follows:

Alkalithia Spring, Alkalithia Springs, Alexander County.
Haywood White Sulphur Springs, Waynesville, Haywood County.
Mida Spring, near Charlotte, Mecklenburg County.
Panacea Springs, near Littleton, Warren County.
Parks Mineral Spring, Caswell County, near Danville, Va.
Thompson Bromine Arsenic Springs, Crumpler, Ashe County.
Vade Mecum Spring, Vade Mecum, Stokes County.

NORTH DAKOTA.

For the first time North Dakota is represented in our report. The 1 spring reporting sales for 1904 is the following:

Hydatso Spring, Tower City, Cass County.

OHIO.

The list for Ohio is increased by 3 springs, making a total for 1904 of 25. Of these, however, only 13 report sales. They are the following:

Arcadian Springs, Mineral Springs, Adams County.
Buckeye Lithia Spring, near Martins Ferry, Belmont County.
Crum Mineral Spring, Austintown, Mahoning County.

Fisher's Magnesia Mineral Spring, Clinton Township, Franklin County.
Painesville Mineral Spring, Painesville, Lake County.
Puritas Spring, Rockport, Cuyahoga County.
Purtlebaugh Mineral Spring, Urbana, Champaign County.
Rex Ferro-Lithia Springs, New Richmond, Clermont County.
Ripley Brom-Lithia Springs, Ripley, Brown County.
Sand Rock Mineral Spring, near Canton, Stark County.
Tallewanda Mineral Springs, near College Corner, Preble County.
Wheeler Mineral Springs, Youngstown, Mahoning County.
Woods' Lithia Spring, near Bridgeport, Belmont County.

OKLAHOMA.

Only 1 of the 2 springs credited to Oklahoma reports sales for 1904. It is the following:

Lewis Crystalline Lithia Wells, Oklahoma City, Oklahoma County.

OREGON.

The list for Oregon is increased by 1 spring, making a total of 10 for 1904. Of these the following 8 report sales:

Boswell Springs, Boswell, Douglas County.
Cascade Mineral Spring, Cascadia, Linn County.
Colestin Spring, Colestin, Jackson County.
Lehman Spring, Blue Mountains, Umatilla County.
Siskiyou or Wagner's Mineral Spring, Hubbard, Marion County.
Sodaville Mineral Springs, Sodaville, Linn County.
Wilhoit Springs, Wilhoit, Clackamas County.
Wolfer's Mineral Spring, Hubbard, Marion County.

PENNSYLVANIA.

There is a net loss of 3 springs in the list for Pennsylvania, 1 having been added and 4 dropped. The total for 1904 is 35, and of these only 21 report sales. They are the following:

Bedford, Chalybeate Spring, Bedford, Bedford County.
Buena Vista Springs, Buena Vista, Franklin County.
Charmian Mineral Spring, Charmian, Franklin County.
Cloverdale Artesian Lithia Spring, Newville, Cumberland County.
East Mountain Lithia Well, near Factoryville, Wyoming 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.
Magnesia Spring, Cambridge Springs, Crawford County.
Pavilion Spring, South Mountain, Wernersville, Berks County.
Pocono Mineral Spring, Bucks Township, Luzerne County.
Pulaski Natural Mineral Spring, Pulaski, Lawrence County.
Ross-Common Springs, Windgap, Monroe County.
Saegerstown Mineral Spring, Saegerstown, Crawford County.
Sizer Mineral Spring, Sizerville, Cameron 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 House Spring, Neversink Mountain, Reading, Berks County.
White Sulphur Spring, Bedford Springs, Bedford County.

RHODE ISLAND.

The list for Rhode Island remains the same as in 1903. All of the 4 springs credited to the State report sales for 1904. They are the following:

Perry Spring, Providence, Providence County.
Gladstone Spring, Narragansett Pier, Washington County.
Holly Mineral Spring, Woonsocket, Providence County.
Ochee Mineral and Medicinal Springs, Johnston, Providence County.

SOUTH CAROLINA.

To the South Carolina list 1 spring is added; the total for 1904 is 11, and of these 5 report sales. They are the following:

Buffalo Lick Springs, near Carlisle, Union County.
Cherokee Springs, near Spartanburg, Spartanburg County.
Glowing Spring, near Calhoun Falls, Abbeville County.
Harris Lithia Spring, Harris Springs, Laurens County.
White Diamond Lithia, near Kings Creek, York County.

SOUTH DAKOTA.

No reports of sales for 1904 have been received from the 2 spring localities credited to South Dakota.

TENNESSEE.

No change is made in the list for Tennessee, the total still being 14. Of these the following 13 report sales for 1904:

Eastbrook Springs, Eastbrook, Franklin County.
Hinson Springs, Hinson Springs, Henderson County.
Horn Mineral Springs, Horn Springs, Wilson County.
Idaho Springs, near Clarksville, Montgomery County.
Larkins Spring, Madison, Davidson 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 Springs, Grainger County.
Tillman Spring, near Nashville, Davidson County.
Whittle Springs, Whittle Springs, near Knoxville, Knox County.
Willow Brook Spring, Craggie Hope, Cheatham County.

TEXAS.

The Texas list for 1904 gains 3 springs, making a total of 31; of these, however, only 14 report sales. They are the following:

Capp's Wells, Longview, Gregg County.
China Spring Well, China Springs, McLennan County.
Dullnig Mineral Wells, near San Antonio, Bexar County.

Lone Star Spring, near Texarkana, Bowie County.
Milford Mineral Well, Milford, Ellis County.
Mineral Wells, Palo Pinto County:
  Cicero Smith Well.
  Congress Well.
  George P. Barber Wells.
  Gibson Well.
  Hawthorne Well.
  Star Well.
Peterman Mineral Spring, Mount Pleasant, Titus County.
Texarkana Spring, Texarkana, Bowie County.
Wootan Wells, Wootan Wells, Robertson County.

UTAH.

Of the 3 springs credited to Utah only 1 reports for 1904. It is the following:

Deseret Lithia Well, Deseret, Millard County.

VERMONT.

The list for Vermont loses 1 spring, leaving a total of 6 for 1904. All of them report sales. They are the following:

Alburg Chalybeate, Lithia, and Sulphur Springs, Alburg Spring, Grand Isle County.
Brunswick Mineral Spring, Brunswick, Essex County.
Clarendon Springs, Clarendon Springs, Rutland County.
Equinox Spring, Manchester, Bennington County.
Missisquoi Mineral Springs, Sheldon, Franklin County.
Newfame or Vermont Mineral Spring, Putney, Windham County.

VIRGINIA.

To the Virginia list 1 spring has been added, making a total of 59 springs for the State. Of these 35 report sales for 1904. They are the following:

Aetna Lithia Springs, Roanoke, Roanoke County.
Augusta White Lithia Spring, near Augusta Springs, Augusta County.
Alleghany Springs, Montgomery County.
Bear Lithia Springs, near Elkton, Rockingham County.
Bath Alum Spring, Bath 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.
Mecklenburg or Chase City Mineral Springs, Chase City, Mecklenburg County.
Crockett Arsenic Lithia Spring, Shawsville, Montgomery County.
Diamond Spring, Norfolk County.
Farmville Lithia Springs, No. 2, Cumberland County, near Farmville, Prince Edward County.
Fonticello Lithia Spring, Chesterfield County, near Richmond.

Harris Anti-Dyspeptic and Tonic Spring, Burkeville, Nottoway County.
Jeffress Lithia Silica Springs, Jeffress, Mecklenburg County.
Lone Jack Spring, Candles Mountain, Campbell 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.
Otterburn Lithia and Magnesia Springs, Amelia, Amelia 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.
The Kayser Lithia (formerly Virginia Waukesha Lithia) Springs, Staunton, Augusta County.
Wallawhatoola Alum Springs, near Millboro Spring, Bath County.
Como Lithia Spring, East Richmond, Henrico County.
Paeonian Spring, Paeonian Springs, Loudoun County.
Rockingham (Va.) Springs, near McGaheysville, Rockingham County.
Rubino Healing Lithia Spring, Healing Springs, Bath County.
Sublett's Lithia Spring, near Danville, Pittsylvania County.
Virginia Lithia (formerly Swineford's Arsenic Lithia) Springs, Osceola, Chesterfield County.

WASHINGTON.

There is no change in the list for the State of Washington, the total being 4, as in 1903, and all report sales for 1904. They are as follows:

Cascade Springs, near Cascades, Skamania County.
Medical Lake, Medical Lake, Spokane County.
Olympia Hygeian Spring, Tumwater, Thurston County.
Yakima Natural Mineral Spring, near North Yakima, Yakima County.

WEST VIRGINIA.

The list for West Virginia is the same as in 1903, the total being 11. Of these only 4 report sales in 1904. They are the following:

Borland Mineral Well, Wood County, near Salama.
Manacea Irondale Spring, near Independence, Preston County.
Pence Spring, Pence Springs, Summers County.
Triplet Well, Calf Creek, Grant District, Pleasants County.

WISCONSIN.

There is a net gain for Wisconsin of 1 spring, 2 having been added to the list and 1 taken from it. Of the 38 springs credited to the State 25 report sales for 1904. They are the following:

Allouez Magnesia Springs, Green Bay, Brown County.
Alta Springs, Dunfield, Lincoln County.
Bay City Spring, Ashland, Ashland 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.
Solon Springs, Upper St. Croix Lake, Douglas County.
Waukesha Springs, Waukesha County:
- Anderson's Waukesha Spring.
- Arcadian Spring.
- Bethesda Mineral Spring.
- Fountain Spring.
- Glen Rock Spring.
- Henk Mineral Spring.
- Minniska Mineral Spring.
- Siloam Mineral Spring.
- Waukesha Imperial Spring.
- White Rock Mineral Spring.

Sulphur Mineral Spring, near Oshkosh, Winnebago County.
Bethania Mineral Springs, Osceola, Polk County.
St. Johns Mineral Springs, Green Bay, Brown County.

WYOMING.

No reports have been received for 1904 from the 2 springs credited to the State of Wyoming.

IMPORTS.

The following tables show the imports of mineral waters from 1867 to 1904, inclusive:

Mineral waters imported and entered for consumption in the United States, 1867–1904.

Fiscal year ending June 30—	In bottles of 1 quart or less.		In bottles in excess of 1 quart.		Not in bottles.		All not artificial.		Total value.
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	
	Bottles.		*Quarts.*		*Gallons.*		*Gallons.*		
1867	370,610	$24,913	3,792	$360	....	$137	....	....	$25,410
1868	241,702	18,438	22,819	2,052	554	104	....	....	20,594
1869	344,691	25,635	9,739	802	1,042	245	....	....	26,682
1870	433,212	30,680	18,025	1,743	2,063	508	....	....	32,931
1871	470,947	34,604	2,320	174	1,336	141	....	....	34,919
1872	892,913	67,951	....	....	639	116	....	....	68,067
1873	35,508	2,326	....	....	355	75	394,423	$98,151	100,552
1874	7,238	691	....	....	95	16	199,035	79,789	80,496
1875	4,174	471	....	....	5	2	395,956	101,640	102,113
1876	25,758	1,899	....	....	....	....	447,646	134,889	136,788
1877	12,965	1,328	....	....	....	22	520,751	167,458	168,808
1878	8,229	815	....	....	....	....	883,674	350,912	351,727
1879	28,440	2,352	....	....	3	4	798,107	282,153	284,509
1880	207,554	19,731	....	....	....	....	927,759	285,798	305,529
1881	150,326	11,850	....	....	55	26	1,225,462	383,616	395,492
1882	152,277	17,010	....	....	....	....	1,542,905	410,105	427,115
1883	88,497	7,054	....	....	....	....	1,714,085	441,439	448,493

Mineral waters imported and entered for consumption in the United States, 1867–1904—Continued.

Year ending—	Artificial mineral waters.		Natural mineral waters.	
	Quantity.	Value.	Quantity.	Value.
June 30—	*Gallons.*		*Gallons.*	
1884	29,366	$4,591	1,505,298	$362,651
1885	7,972	2,157	1,660,072	397,875
Dec. 31—				
1886	62,464	16,815	1,618,960	354,242
1887	13,885	4,851	1,915,511	385,906
1888	12,752	4,411	1,716,461	341,695
1889	36,494	8,771	1,558,968	368,661
1890	22,328	7,133	2,322,008	433,281
1891	26,700	8,700	2,019,833	392,894
1892	16,052	9,089	2,266,123	497,660
1893	6,086	2,992	2,321,081	506,866
1894	7,753	3,047	1,891,964	417,500
1895	101,115	19,151	2,104,811	506,384
1896	51,108	11,739	2,273,393	551,097
1897			[a] 2,942,200	[a] 501,684
1898			[a] 1,955,723	[a] 526,071
1899			[a] 2,382,410	[a] 663,803
1900			[a] 2,485,042	[a] 687,874
1901			[a] 2,567,323	[a] 744,392
1902			[a] 2,461,830	[a] 712,827
1903			[a] 2,851,964	[a] 846,294
1904			[a] 2,901,828	[a] 868,262

[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 eight years, although each year the imports have usually 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	$1,029
1876	80	1882	421
1879	1,529	1883	[a] 459
1880	1,486		

[a] None reported since 1883.

UNITED STATES GEOLOGICAL SURVEY MINERAL WATER EXHIBIT AT THE LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, 1904.

A mineral-water exhibit by the United States Geological Survey was installed and classified by Dr. A. C. Peale in a separate inclosure in the Mines and Metallurgy building at the St. Louis Exposition. One hundred and twenty-one springs were represented in the exhibit, and the waters, neatly bottled as put up for sale, were geographically arranged in cases, a shelf being assigned to each spring. Descriptive circulars of each spring, accompanied by analyses, were also exhibited. The analyses of the spring waters were also illustrated by a series of jars, a large jar of the capacity of a gallon representing the amount of water, while the proportions per gallon of the various ingredients were shown in smaller bottles. Printed analyses for all the spring waters were shown on cards in connection with this portion of the exhibit. The following list, arranged by States, enumerates the different waters shown in this collection:

Alabama:
- Cherokee Mineral Water, Citronville.

Arizona:
- Agua Caliente Springs, Maricopa County.
- Castle Creek Hot Springs, Castle Creek.

Arkansas:
- Eureka Springs, Eureka Springs.
- Potash Sulphur Springs, Lawrence.
- Mountain Valley Water, (near) Hot Springs.
- Ravenden Springs, Ravenden Springs.

California:
- Castle Rock Spring, Castella.
- Bartlett Spring, Bartlett Springs.
- Napa Soda Spring, Napa County.
- Yosemite Crystal Spring Water, Blairs Mineral Spring.
- Paraiso Mineral Water, Salinas, near Jamesburg.
- Castalian Water, Inyo County.

Colorado:
- Sulphur Springs, Sulphur Springs.
- Clark Magnetic Mineral Water, Pueblo.
- Canyon City Vichy Springs, Canyon City.
- Yampah Springs, Glenwood Springs.
- Colorado Lithia Water, Pueblo.
- Columbia Mineral Water, Denver.
- Manitou Springs, Manitou.

Connecticut:
- Stafford Spring, Stafford Springs.

Canada:
- Abenakis Spring.

Florida:
- Orange City Springs, Orange City.
- Magnolia Springs, Magnolia Springs.

Idaho:
- Idanha Natural Lithia Spring, Soda Springs.

Illinois:
- Gravel Springs, Jacksonville.
- Sanicula Springs, Ottawa.
- Aqua Vitae Mineral Water, Maquon.

Indiana:
- Blue Cast Magnetic Springs, Fort Wayne.
- West Baden Springs, West Baden.
- Pluto Spring Water, French Lick.
- Ugogo Mineral Water, Martinsville.

Iowa:
- Red Mineral Spring Water, Eddyville.
- Boone Mineral Water, Boone.

Kansas:
- Abilen A Water, Abilene.
- Hoover's Mineral Spring, Onaga.
- Sycamore Mineral Water, Sabetha.
- Geuda Springs, Geuda Springs.
- Sand Springs, Abilene.
- California Spring, Ottawa.
- Waconda Spring, Waconda.
- Delaware Spring, Fredonia.

Kentucky:
- Blue Lick Water, Blue Lick Spring.

Louisiana:
- Abita Springs, St. Tammany Parish.

Maine:
- Raymond Spring Water, Raymond.
- Poland Spring Water, Androscoggin County.
- Highland Spring Water, Androscoggin County.
- Mount Hartford Lithia Water, Oxford County.

Massachusetts:
- Howe Spring, Millbury.
- Pepperell Mineral Spring, Pepperell.
- Ballardvale Lithia Water, Ballardvale.
- Myles Standish, South Duxbury.
- El-Azhar, Lowell.

Michigan:
- Eastman Springs, Benton Harbor.
- Pagoda Spring Water, Mount Clemens.
- Prosit Flowing Well, Flint.

Minnesota:
- Owatonna Vichy Spring Water, Steele County.

Mississippi:
- Castalian Mineral Spring Water, Castalian Springs.
- Arundel Lithia Water, Meridian.

Mississippi—Continued.
- Iuka Mineral Springs, Iuka.
- Tallaha Mineral Spring Water.
- Stafford Mineral Spring Water, Vosburg.

Missouri:
- B. B. Bitter Mineral Springs, Bowling Green.
- Crystal Lithia Spring Water, Excelsior Springs.
- Belcher Mineral Water, St. Louis.
- Old Orchard Mineral Water, Old Orchard.
- Wyaconda Diuretic Mineral Water, La Grange.
- Windsor Water, St. Louis.
- Chalybeate Spring, Mooresville.
- Jackson Lithia Spring, Kansas City.
- Regent Mineral Spring, Excelsior Springs.
- Sulpho-Saline Spring, Excelsior Springs.

New Hampshire:
- Londonderry Lithia Spring Water, Londonderry.

New York:
- Congress Spring Water, Saratoga Springs.
- White Sulphur Spring, Sharon Springs.
- Hathorn Water, Saratoga Springs.
- Star Spring Water, Saratoga Springs.
- Lincoln Spring Water, Saratoga Springs.
- Saratoga Adirondack Spring Water, Saratoga Springs.
- Saratoga Vichy Spring Water, Saratoga Springs.
- Quevic Springs, Saratoga Springs.
- Excelsior Spring Water, Saratoga Springs.
- Great White Sulphur Spring, Richfield.
- Allen Springs, Watkins Glen.

North Carolina:
- Jackson Springs, Jackson Springs.
- Vade Mecum Mineral Water, Stokes County.
- Eupeptic Springs, Statesville.

Ohio:
- Oakridge Mineral Spring, Greenspring.

Pennsylvania:
- Saegerstown Mineral Water, Saegerstown.
- Purock Water, Malvern.
- Ross Common Spring Water, Windgap, near South Bethlehem.
- Ephrata Mountain Spring, Lancaster County.
- Gray Mineral Spring, Cambridge Springs, Crawford County.

South Carolina:
- Harris Lithia Water, Harris Springs.
- White Stone Springs, White Stone Springs.

Tennessee:
- Lockeland Spring, Nashville.
- Wright's Epsom Lithia Water, Mooresburg.
- Tate Epsom Spring, Tate Springs.
- Whittle Springs, Whittle Springs.
- Eastbrook Spring Water, Eastbrook.

Texas:
- Milford Mineral Well, Milford.
- Dullnig's Well Water, San Antonio.

Vermont:
- Dearborn's Natural Mineral Water, Woodstock.

Virginia:
- Blue Ridge Virginia Spring Water, Blueridge Springs.
- Alleghany Springs, Alleghany Springs.
- Chase City Lithia Water, Chase City.
- Buffalo Lithia Springs, Buffalo Lithiasprings.
- Nye Mineral Water, Wytheville.

West Virginia:
- Pence Spring, Pence Spring.
- White Sulphur Springs, White Sulphur Springs.
- Webster Springs.
- Manacea or Irondale Spring Water, Independence.

Wisconsin:
- Bethesda Mineral Water, Waukesha.
- Chippewa Springs, Chippewa Falls.
- Sheboygan Spring Water, Sheboygan.
- Arcadian Lithia Water, Waukesha.
- Waukesha Imperial Water, Waukesha.
- White Rock Lithia Water, Waukesha.
- Blue Rock Mineral Water, Janesville.
- Allouez Mineral Spring, Greenbay.

Wyoming:
- Rawlins Spring, Rawlins.

PRODUCTION OF MONAZITE, ZIRCON, GADOLINITE, AND COLUMBITE OR TANTALUM MINERALS.

By Joseph Hyde Pratt.

INTRODUCTION.

The minerals monazite, zircon, gadolinite, and columbite are mined for similar purposes—that is, for use in the manufacture of electric and incandescent lamps. Of these minerals the production of monazite is at the present time of the greatest importance, the others having been produced in much smaller quantities. With the exception of a part of the monazite and the columbite, all of the output of these minerals is used in the United States. A portion of the monazite and the columbite was exported to Germany. The demand for monazite is constantly increasing, while there is but little increase in the use of zircon and gadolinite. The demand for columbite and other tantalum minerals has only arisen during the last year, and it can not now be predicted to what extent these minerals will be used.

It may be of interest to note here that of these minerals all but the monazite have been found and mined in pegmatitic dikes. Monazite has been obtained from placer or alluvium deposits and was originally an accessory mineral in adjacent gneisses. It is also interesting to note that all four of these minerals were formerly considered as among the rare minerals, and it was not until a commercial demand arose for them that they were found in any large quantity. When, however, uses arose for them, investigations were made as to sources of supply and deposits were soon located where they could be obtained in sufficient quantity to supply the demand.

MONAZITE.

Monazite is essentially an anhydrous phosphate of the rare earths cerium, lanthanum, and didymium, but usually contains a small and varying percentage of thoria. Monazite varies considerably in color, being light-yellow to honey-yellow, reddish, brownish, and yellowish-green, and it has a 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.

It is the presence of thoria in the monazite that gives it its commercial value. There is, however, a considerable variation in the percentage of thoria found in the pure monazite and consequently in the commercial product, which is in the form of sand and contains from 3 to 9 per cent of this oxide. The thoria is used in the manufacture of the mantles for the Welsbach and other incandescent gaslights. The Welsbach light consists of a cylindrical hood or mantle composed of a fibrous network of the rare earths, the top of which is drawn together and held by a loop of platinum wire. When in use this mantle is suspended over the flame of a burner constructed on the principle of the Bunsen burner, in which the heating, instead of the illuminating power of the hydrocarbons of the gas is used by burning it with an excess of air. In this manner the mantle becomes incandescent and glows with a brilliant and uniform light. In the manufacture of these mantles a cylindrical network about 1½ inches in diameter is woven out of the best and strongest cotton thread, which is first washed in ammonia and then in warm water, being wrung out in a mechanical clothes wringer each time. The next operation is the soaking of this cotton network in a solution of the rare earths, after which it is dried in a revolving hot-air bath. This network is then cut to a length required for the hood; the cylindrical pieces are shaped over a wooden form, the upper end being drawn together by means of platinum wire. The cotton fiber is eliminated by heating the mantles over a hot Bunsen burner flame, thus leaving the hood composed of the thoria and other chemical compounds. During the burning of the cotton thread there is some shrinkage in the size of the hood. The exact composition of the hoods is not generally known, as it is a trade secret, but they are composed largely of thoria with smaller quantities of the lanthanum and didymium oxides.

A portion of the cerium obtained in the reduction of the monazite is prepared for market in the form of the oxalate and is used in the drug trade.

In the chemical laboratory of the Welsbach Lighting Company, of Gloucester City, N. J., there have been a great many chemical compounds made of the rare earths found in monazite, and considerable experimental work has been done as to any economic use that could be made of these compounds. During 1904 a series of experiments was made by Messrs. Charles Baskerville and T. B. Foust[a] as to the eco-

[a] Jour. Soc. Chem. Ind., February, 1904, p. 104.

nomic value of some of these rare earth compounds as mordants. The compounds of the rare earths that were used in these experiments consisted of praeseodidymium hydroxide; neodidymium, lanthanum, and praeseodidymium acetates, and a mixture of the sulphates of these elements, or the so-called pink salts. These experiments showed that no commercial results would be obtained by using them as mordants, although in a majority of cases slight differences were produced, and in a few the variation was marked. In summing up the results of their work they state that—

The rare earths can have little practical application as mordants, for the following reasons: (1) Because they do not possess the mordanting action to a degree which would allow competition with known mordants; (2) because the supply is somewhat limited and would not admit of extended use; (3) their cost, which even in the event of the first and second considerations being favorable, would bar their practical use extensively. Therefore it is only a matter of theoretical interest to note this property of the rare earths.

In a recent publication on the "Origin of Radium," Mr. Bertram B. Boltwood has shown that the proportionality between the uranium and the radium in minerals is constant. In carrying out these investigations a series of 22 separate samples, comprising 12 distinct mineral species, were used, among which were 4 samples of monazite, 1 from North Carolina in the form of sand and containing 5 per cent of thoria and 0.43 per cent of uranium; 1 from Connecticut, representing a massive specimen which contained about 8 per cent of thoria and 0.30 per cent of uranium; a third from Norway, representing a single good sized crystal and containing from 7 to 9 per cent of thoria and 0.41 per cent of uranium; and the fourth from Brazil, which was in the form of sand and contained about 5 per cent of thoria and 0.31 per cent of uranium. In the following table the results obtained in the examination of the monazite minerals are given, together with the results of the other minerals for comparison. Column I gives the activity of the emanations contained in one gram of the mineral; column II, the activity of the emanation lost by one gram of the mineral at ordinary temperatures; column III, the sum of the two previous activities (total emanation equivalent to the radium content in one gram of the mineral); column IV, the percentage of the total emanation lost by diffusion from the cold mineral (the emanating power of the mineral at ordinary temperatures); column V, the weight (in grams) of the uranium content in one gram of mineral; column VI, the ratio of the radium to the uranium (the number obtained on dividing the total activity, column III, by the quantity of uranium, column V).

Comparative results obtained in the examination of monazite and other minerals.

No. of specimen.	Substance.	Locality.	I.	II.	III.	IV.	V.	VI.
1	Uraninite	North Carolina	150.7	19.3	170.0	11.3	0.7465	228
2	....do	Colorado	147.1	8.0	155.1	5.2	.6961	223
3	Gummite	North Carolina	126.7	20.3	147.0	13.7	.6538	225
4	Uraninite	Joachimsthal	131.8	7.8	139.6	5.6	.6174	226
5	Uranophane	North Carolina	108.0	9.7	117.7	8.2	.5168	228
6	Uraninite	Saxony	112.5	3.1	115.6	2.7	.5064	228
7	Uranophane	North Carolina	88.8	24.7	113.5	22.8	.4984	228
8	Thorogummite	....do	61.1	11.8	72.9	16.2	.3317	220
9	Carnotite	Colorado	41.6	8.1	49.7	16.3	.2261	220
10	Uranothorite	Norway	24.9	.3	25.2	1.3	.1138	221
11	Samarskite	North Carolina	23.2	.16	23.4	.7	.1044	224
12	Orangite	Norway	22.84	.26	23.1	1.1	.1034	223
13	Euxenite	....do	19.8	.10	19.9	.5	.0871	228
14	Thorite	....do	15.6	1.0	16.6	6.2	.0754	220
15	Fergusonite	....do	11.95	.07	12.0	.5	.0557	215
16	Aeschynite	....do	9.98	.02	10.0	.2	.0452	221
17	Xenotime	....do	1.14	.40	1.54	26.0	.0070	220
18	Monazite	North Carolina	.88	.00	.88	....	.0043	205
19	....do	Norway	.84	.01	.85	1.2	.0041	207
20	....do	Brazil	.76	.00	.76	....	.0034	223
21	....do	Connecticut	.63	.00	.63	....	.0030	210
22	Allanite	North Carolina	.014	.00	....	....	(0.00007)	......

From the data given in the table it is evident that a direct proportionality (within the limits of experimental error) exists between the quantities of radium and the quantities of uranium, and the inevitable and only possible conclusion is that uranium is the parent of radium. The participation by thorium in the production of radium, which has been suggested by some, is entirely excluded, since the radium-uranium ratio in the thorites, containing approximately 50 per cent of thorium, is the same as that in such minerals as carnotite and uranophane, where the content of thorium is not over a few hundredths of a per cent at the highest.

One of the interesting facts brought out by Mr. Boltwood's investigations, especially as they refer to monazite, is that the thorium has apparently no participation in the production of radium and that the radioactivity of monazite is due to its uranium contents.

The sources of supply of monazite in the United States are still the deposits in North and South Carolina, and the entire production for 1904 was obtained from these States. As there are but one or two producers of some of the minerals discussed in this paper, the outputs are given combined with the output of monazite.

The Brazilian monazite deposits still remain in the control of one firm, and nearly of the monazite that is shipped is obtained from the State of Bahia. Recently the Brazilian Government has granted concessions for exploration and work in the State of Espirito Santo. As far as can be learned, the monazite sand in this latter State is not as pure as that obtained from Bahia and will, consequently, cost more to prepare for market.

ZIRCON AND GADOLINITE.

The output of these two minerals is used almost exclusively in the manufacture of chemical compounds that are utilized in the construction of the glower of the Nernst lamp. The zircon is mined for its zirconia content, and from the gadolinite is obtained yttria, these two oxides representing the principal ones used in the glower. The zircon is obtained entirely from the deposits in Henderson County, N. C., and the gadolinite is obtained from Llano County, Tex.

The occurrence of zircon has been described in the report on monazite and zircon for 1903.

OCCURRENCE OF GADOLINITE.

Gadolinite is a basic orthosilicate composed principally of beryllium oxide (glucina), iron protoxide, and the yttrium oxides. The yttria earths, or, as they are sometimes called, the "gadolinite earths" are partially replaced by the oxides of cerium, lanthanum, and didymium. Many of the gadolinite specimens also show a very small quantity of thoria, this being less than 1 per cent. The mineral crystallizes in the monoclinic system, commonly prismatic and terminated by the base. The crystals are usually rough and coarse, showing no cleavage, but having a conchoidal to splintery fracture. It is a brittle mineral, and has a hardness of 6.5 to 7. It varies considerably in specific gravity, according to the percentage of yttrium oxides, from 4 to 4.5 In color gadolinite is greenish black and sometimes brown; in thin splinters it is nearly transparent, and usually of a grass-green to olive-green color. Its luster is vitreous to greasy.

The principal occurrence of gadolinite is in pegmatitic dikes or veins, and it is very often associated with allanite and other minerals containing some of the rare earth oxides. The first discovery of this mineral in the United States was at Devils Head Mountain, Douglas County, Colo., and was described and analyzed by Mr. L. G. Eakins,[a] of the United States Geological Survey. Only a small quantity of this mineral was obtained from Colorado.

The only other locality in the United States where gadolinite is known positively to occur is in Llano County, Tex., at what is known as Barringer Hill, 5 miles south of Bluffton, on the west bank of the

[a] Proc. Colorado Sci. Soc., vol. 2, pt. 1, 1885, p. 32.

Colorado River. The mineral has been found here in considerable quantity in a pegmatitic dike associated with allanite, yttrialite, nivenite, fergusonite, cyrtolite, gummite, fluorite, molybdenite, and a number of other minerals. The rocks of this district are Archean, which are occasionally capped with limestone. The Archean granite is of various shades of color and texture, of which the most abundant is a cross-grained, deep-red granite, penetrating through which are numerous and rather extensive pegmatitic dikes exposed on the surface, and, according to Mr. Hidden, it is only in these veins or dikes that the yttria minerals have been found. The larger masses of the gadolinite have been found in the wider portions of the veins, which in some instances are seen at the present time as permanent uplifts, or mound-like elevations, and which, 100 to 150 feet in area, rise conspicuously from the surrounding country to elevations of from 25 to 30 feet. The principal one of these mounds is Barringer Hill, which has been the scene of the principal exploration. This mound is nearly circular in form, and its contact with the granite is sharply defined. The extensions of the pegmatitic dike, of which it is a part, can readily be traced in a southwesterly direction for some distance.

Some of the largest masses of gadolinite known have been obtained from this locality, and when a commercial demand arose for the mineral, it was this Texas locality that was found to contain a sufficient quantity to answer the demand of the market, and now all of this mineral that is mined for its yttrium oxides is obtained from this locality.

The first specimen of gadolinite was discovered by Mr. J. J. Barringer[a] in July, 1886, the mass weighing about 1½ pounds. A black mineral was noticed projecting from an outcrop of pegmatite, and on account of its peculiar appearance and weight, it was broken out and preserved. Upon further investigation Mr. Barringer unearthed a bunch of huge crystals or a mass of gadolinite that aggregated not less than 500 kilos. This quantity was obtained by simply digging with a pick and shovel in the partly decomposed pegmatite, and came from a space not over 4 feet deep, 3 feet wide, and 8 feet long. This mineral was not recognized when first discovered, and was known locally as "tin-stone," "black-jack," and "volcanic glass." It was also mistaken for samarskite, and was known by this name until August, 1888, when Mr. Barringer sent a specimen of it to New York in order to obtain a market for it as samarskite, and its true character was discovered. On account of the variety of minerals containing the rare earths found at this locality, the property was purchased by Mr. W. E. Hidden, of

[a] Am. Jour. Sci. 3d ser., vol. 38, 1889, pp. 474–486, and Univ. of Texas Min. Survey, Bull. No. 5, 1902, p. 31.

Newark, N. J., and others, and considerable work was done in order to obtain the rare earth minerals. During the investigations of Mr. Hidden and Mr. J. B. Mackintosh, several new mineral species were discovered at this Llano County locality, and the results of the investigations have been described in a paper entitled "A Description of several Yttria and Thoria Minerals from Llano County, Texas."[a] The list of species identified by them from this locality includes "quartz, hyalite, orthoclase, albite, biotite, muscovite, magnetite, martite, gadolinite (several varieties due to alteration), fergusonite (three varieties of hydrous species), allanite, rowlandite, molybdenite, molybdite, cyrtolite (several varieties), fluorite, gummite (two varieties), a carbonate of the rare earths (tengerite?), nivenite, a hydrated thorium-yttrium-lead uranate, a hydrous uranium-thorosilicate, an yttrium-thorium silicate, and a fetid gaseous compound."

About 1902 this property was transferred to the Nernst Lamp Company, of Pittsburg, Pa., and since that time it has been operated for gadolinite, its yttria contents being used in the manufacture of the Nernst lamp.

The work has been in charge of Mr. W. E. Hidden,[b] and during the winter of 1902–1903 some notable discoveries were made in the rare earth minerals at this locality. One was a double crystal of gadolinite that weighed 73 pounds, and another an 18-pound mass of yttrialite. Other finds were a mass of pure allanite that weighed over 300 pounds; about 50 pounds of thoro-gummite, some pieces weighing a pound and some being in good crystals; pure masses and large aggregations of fergusonite up to 5 pounds in weight; and a pure mass of rowlandite that weighed 1 kilo. During the four months that the mine was in operation there were sufficient yttria ores taken out for the company's needs for the rest of the year. The work was continued during the winter of 1903 and 1904, and about 1,000 pounds of very pure gadolinite were taken out, the largest mass of this mineral that was found being a roughly crystallized mass that measured 36 inches long and 11 inches thick at the widest part, and weighed a little over 200 pounds. It was very pure, having a specific gravity of 4.28. Other finds during this winter's work were nearly a pound of very pure nivenite, about an ounce of mackintoshite, and a considerable quantity of cyrtolite, fergusonite, and thoro-gummite.

In addition, there was found about 10 grams of a white mineral, which has been tentatively referred to tengerite and was obtained by carefully detaching it bit by bit from over 300 kilos of fresh gadolinite. It occurred in the gadolinite in some globular and flat radiated

[a] Am. Jour. Sci. 3d ser,. vol. 38, 1889, pp. 474–486.

[b] For detailed description of the results of this work see Am. Jour. Sci., 4th ser., vol. 19, 1905, pp. 425–433.

concretions in the cracks and fissures. This has been analyzed by Dr. W. F. Hillebrand, of the United States Geological Survey, who reports the following regarding it: [a]

The purest material that could be picked out from that at my disposal showed some brown admixture with the white. The following results were obtained from 0.3640 gram of this selected material after deducting 0.0262 gram of residue, left after long treatment of the ignited powder with coal and quite dilute nitric acid:

Analysis of tengerite (?) from Llano County, Tex.

	Per cent.
Y_2O_3 group	40.80
Ce_2O_3 group	7.00
Fe_2O_3	4.00
BeO	9.70
CO_2	19.60
H_2O above 105°	14.1
H_2O below 105°	3.20
SiO_2	.40
MgO, Alk., loss	1.20
Total	100.00

The calculated ratios lead to nothing definite, except that the white mineral appears to be a hydrous basic carbonate, but whether a double carbonate of the rare earth metals and glucina (beryllium oxide), or a mixture, there are no present means of deciding.

CHEMICAL COMPOSITION.

The yttria content of gadolinite varies considerably, the lowest percentage recorded being that of a variety from Douglas County, Colo., which gave 0.22 and 0.24 per cent, while the highest recorded was a variety from Ytterby, near Stockholm, Sweden, which contained 47.06 per cent. Both the Colorado and the Texas gadolinites have been analyzed, and in the following table are given several analyses of different specimens from each of these localities. Analyses I, II, and III are of the Llano County, Tex., gadolinite, the first two having been made by Mr. F. A. Genth [b] and the third by Mr. L. G. Eakins. [c] Analyses III and IV of the Colorado gadolinite were by Mr. L. G. Eakins. [d]

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[a] Am. Jour. Sci., 4th ser., vol. 19, 1905, p. 429.

[b] Am. Jour. Sci., vol. 38, 1889, p. 200.

[c] Am. Jour. Sci., vol. 38, 1889, p. 479.

[d] Proc. Colorado Sci. Soc., vol. 2, pt. 1, 1885, p. 32, and Dana's Mineralogy, 6th ed., 1892, p. 511.

Analyses of gadolinite from Llano County, Tex.

	I.	II.	III.
SiO_2	22.87	22.80	23.79
Al_2O_3–F_2O_3	.28	.31	.96
Ce_2O_3	2.65	2.66	2.62
$(Di, La)_2O_3$	5.22	5.01	5.22
$(Y, Er)_2O_3$	44.35	44.45	41.55
MnO	.22	.18	Trace.
FeO	13.69	12.93	12.42
BeO	9.24	9.19	11.33
MgO	.07	.11	Trace.
CaO	.64	.71	.74
Na_2O	.20	.23	Trace.
K_2O	.15	.12	Trace.
ThO_2	....	....	.58
P_2O_5	....	....	.05
H_2O	.72	.79	1.03
Insoluble	Not det.	.93	....
Total	100.30	100.42	100.29
Specific gravity	4.201	4.254	4.329

Analyses of gadolinite from Douglas County, Colo.

	III.	IV.
SiO_2	22.13	21.86
ThO_2	.89	.81
Y_2O_3	22.24	28.43
Ce_2O_3	11.10	6.87
$(Di, La)_2O_3$	21.23	19.10
Fe_2O_3	3.47	4.13
FeO	10.43	11.47
BeO	7.19	5.46
CaO	.48	.63
Na_2O	.46	.52
H_2O	.86	.74
Total	100.48	100.02
Specific gravity	4.56	4.59

As is seen from these analyses, the Texas gadolinite contains a considerably higher percentage of yttria than the Colorado, which, on the other hand, is much higher in its percentage of cerium, lanthanum, and didymium oxides. Although the Nernst glower contains principally the oxides of yttrium and zirconium, it also contains very small amounts of erbium, cerium, uranium, thorium, and perhaps others of the rare earths.

There are a number of other minerals containing the yttrium oxides, but none of them that contain a high percentage of these oxides have thus far been found in sufficient quantity to be of commercial value. The following is a list of the principal yttrium minerals:

List of principal yttrium minerals.

Yttrocerite.—A fluoride of calcium, with the metals of the cerium and yttrium groups, which has been found sparingly at Amity, Orange County, N. Y., and at Mount Mica, near Paris, Me. This mineral contains about 14.8 per cent of yttria oxide and 9.3 per cent of cerium oxide.

Tengerite.—A hydrous yttrium carbonate, with something of a chalk-like appearance, which occurs as thin coating on gadolinite at Ytterby, Sweden, and in Llano County, Tex.

Cappelenite.—This mineral is a borosilicate of yttrium and barium, with smaller quantities of cerium, lanthanum, and thorium oxides. It crystallizes in the hexagonal system in thick prisms, and has a conchoidal fracture. Its color is a greenish brown, and it has a vitreous to greasy luster. This mineral has not thus far been identified in the United States, but has been found sparingly in Lille Arö, on the Langesund Fiord, in southern Norway.

Gadolinite.—As described above.

Yttrialite.—This is an amorphous mineral whose chemical composition is chiefly a silicate of thorium and the yttrium oxides, with smaller quantities of cerium, lanthanum, and didymium oxides. The percentage of yttrium oxides is 46.50, and of the thorium oxide 12 per cent. It has a vitreous to greasy luster, and in color on a fresh fracture it is olive green, approaching drab. On the exterior surfaces it is usually altered to orange yellow. It occurs associated with gadolinite at the Llano County, Tex., locality, and is often found implanted upon it. When first found this mineral was called green gadolinite, but its true character was determined by Messrs. W. E. Hidden and J. B. Mackintosh, who gave it the name yttrialite. It has been found at this locality in masses of considerable size, one piece weighing approximately 10 pounds.

Allanite.—This mineral occurs quite commonly in the pegmatitic dikes throughout the United States, and in some localities it has been found in some considerable quantity. It is a silicate of calcium, aluminum, and iron with the rare earth oxides, cerium, lanthanum, and didymium and smaller quantities of the yttrium oxides. The cerium oxides run up as high as 27 per cent, while the yttria oxides are usually less than 3 per cent. No commercial value at the present time is attached to this mineral. Allanite is a pitch brown to black mineral with a submetallic to pitchy or resinous luster, and occurs sometimes in well-developed monoclinic crystals and also massive and in embedded, angular, or rounded grains. In the pegmatitic dikes of Massachusetts, Connecticut, Virginia, North Carolina, and Colorado allanite is a rather commonly associated mineral.

Cenosite.—This mineral is a hydrous calcium-yttrium silicate and carbonate containing about 37.6 per cent of yttrium oxides. It is a mineral of a yellowish-brown color and greasy luster, which is thus far known only in the single specimen that was found on the island of Hitterö, Norway.

Rowlandite.—This is an yttrium silicate that occurs in massive form associated with the gadolinite of Llano County, Texas. It occurs but sparingly and is of a pale drab-green color when pure, but alters to a waxy, brick-red mineral. An analysis gave 61.9 per cent of the yttrium oxides.

Fergusonite.—This mineral is essentially a meta-niobate and tantalate of yttrium with cerium, uranium, etc. The percentage of yttrium oxides varies from about 18 to 26 per cent. It is a mineral with a rather characteristic brownish-black to liver-brown color and a rather dull luster. Its specific gravity is high, being 5.8. It usually occurs massive, but occasionally well-developed tetragonal crystals have been observed. It has been found at a number of localities either in granite, or in pegmatitic dikes, as in granite at Rockport, Mass., and Amelia, Va., and in many of the mica mines of Mitchell County, N. C., and associated with gadolinite in Llano County, Tex. At this latter locality it has been found in masses weighing over a pound.

Yttrotantalite.—This mineral is essentially a tantalate and niobate of iron, calcium, and the rare earth oxides, yttrium, erbium, cerium, and uranium. The yttria contents of this mineral vary from about 10 to 19 per cent. It is of a black to brownish-yellow color with a submetallic to vitreous luster, and has a specific gravity of about 5.8. It has been found in but small quantity at Ytterby, Sweden.

Samarskite.—This mineral is one of the more abundant minerals containing the rare earth oxides, very large quantities of it being found at the Wiseman mine in Mitchell County, N. C. It is essentially a niobate and tantalate of iron and calcium with the cerium and yttrium metals, together with uranium oxide. The yttrium oxides vary from 6 to 15 per cent, and the cerium oxides from about 2 to 6 per cent. The color of samarskite is velvet black, and its luster varies from vitreous to resinous and splendent. It is commonly found massive or in flattened embedded grains, but occasionally in fairly well-developed prismatic rhombohedral crystals. Its usual occurrence is in pegmatitic dikes, and the most noted locality is the Wiseman mica mine in Mitchell County, N. C., where it has been found in masses over 20 pounds in weight. At other mica mines in North Carolina it has been found more sparingly.

Euxenite.—This is a niobate and titanate of yttrium, erbium, cerium, and uranium, which occurs commonly massive and is of a brownish-black color. It has a brilliant to sometimes greasy luster. It has been found at Jölster, Norway, but has not thus far been identified in the United States, unless one of the alteration products of samarskite found at the Wiseman mine in Mitchell County, N. C., can be referred to this mineral.

Polycrase.—This mineral is principally a niobate and titanate of yttrium, erbium, cerium, and uranium similar to euxenite. Its yttrium oxide contents vary from 13 to 27 per cent. It is found usually in orthorhombic, prismatic crystals, which have a conchoidal fracture. It is black in color and of a vitreous to resinous luster. It has been found in the United States near Zirconia, Henderson County, N. C., and in South Carolina about 4 miles from Marietta, Greenville County.

There are many other minerals that contain from a trace to 1 or 2 per cent of yttrium, but are of no interest as possible sources of this oxide. Of the minerals mentioned above but few are known to occur in sufficient quantity to give any promise of being utilized as a commercial source of these oxides. Those that do occur in quantity, as samarskite and fergusonite, are much harder to reduce than the corresponding yttrium silicates.

In the construction of the Nernst glower there is of course but a very small quantity of these oxides used, so that the demand for the crude minerals is very limited.

Recently an interesting article has been published by Mr. E. R. Roberts relating to the Nernst lamp.[a] The fundamental principle of the Nernst lamp is that certain of the rare earths or refractory oxides

[a] Proc. Eng. Soc. Western Pa., vol. 20, 1905, p. 539.

will conduct an electric current and glow after they have been heated to redness. This discovery, which was made by Doctor Nernst in 1897, has resulted in the development and perfecting of the glower, which is now embodied in the Nernst lamp. This glower is composed of a mixture of the rare earth oxides and is made in the form of a small rod or pencil of chalk-like material, having wire terminals at either end. When cold, the glower is an insulator, but by means of the wire the glower becomes heated to redness when a current is passed through these wires, and its resistance gradually decreases until it has reached a red heat, when with 220 volts across the terminals it starts to conduct the current and give light. As stated by Mr. Roberts:

> The heat generated by this current is not only sufficient to maintain independently the glower in an operating state, but causes the resistance to decrease rapidly still further, resulting in a greater and greater flow of current, which would finally result in a ruptured glower if no external resistance with an opposite characteristic were used. For this reason it is essential that the "ballast," consisting of a fine iron wire inclosed in a glass tube be connected in series with the glower; its function being to act as an automatic regulator to prevent the current in the glower circuit from rising materially above its normal value. In practice the ballast performs its duty so well that the lamp will easily withstand an overload of 25 per cent, and may be operated continuously at 5 per cent overload for extended periods without appreciable injury.

In bringing a glower up to its starting point corresponding to a temperature of 1,200° F., use is made of a small electrical heater composed of two or more small tubes of porcelain about 1½ inches long and one-fourth inch in diameter, which are overwound with fine platinum wire, this being in turn held in place and protected from the intense heat later generated by the glower by an outer coating of porcelain paste. After the glower becomes heated, there is, of course, no further use for the heater, and it is cut out by a small electromagnet cut-out, which consists of a magnetic coil connected in series with the glower, an armature, and the necessary contacts in the heater circuit. Thus, when the glower has become heated sufficiently, the current begins to pass through it, and when this becomes sufficiently strong the armature is attracted and the contacts are separated, thus disconnecting the heater from the line.

The cut-out and ballast can be considered as permanent fixtures, or parts of the lamp, as there is but little wear and tear upon them, and they are therefore mounted directly within the body of the lamp. The glower and heater, on the other hand, have a limited life and have to be replaced from time to time. The surface of the glower before being used presents a smooth, white porcelain or chalky appearance, but after having been in service for about 500 hours it is rough and crystalline in appearance. A standard glower is made which takes 0.4 amperes at 210 volts, and the intensity of the lamps is increased by increasing the number of glowers and providing the requisite ballast and cut-outs. Thus, lamps are now being made having 1, 2, 3, 4, or 6 glowers and having maximum intensities varying from 25 to 500 candlepower.

The use of Nernst lamps is constantly increasing, and for some purposes it gives better satisfaction than any other style of electric or illuminating gas lamps. Some of the advantages claimed for the Nernst lamp are: (1) The sunlight character of the light produced, which, on account of its close imitation of sunlight, adapts it especially for use in places such as dry goods stores, art galleries, and other places where colors have to be determined and observed; (2) the high voltage of the Nernst lamp, which causes a saving of line losses and wiring; (3) the perfect steadiness of the light and the absence of shadow; (4) the extreme flexibility of the Nernst system to lighting, owing to the different units available, making it possible to use both large and small units in the same installation and to obtain an illumination which is uniform throughout, both in quantity and quality.

The production of gadolinite and zircon is included under monozite.

TANTALUM MINERALS.

The use of tantalum in the commercial world has arisen within the last year, and is due to the discovery that this metal is capable of withstanding the highest temperature obtained in an incandescent light and that it can be obtained of sufficient ductility to permit of being drawn into very fine wire, which has little tendency to break up when heated by the electric current. The firm of Siemens & Halske, who are manufacturers of incandescent lamps, have been investigating for many years the problem of an economical incandescent lamp and have demonstrated that the visible part of the radiation of an incandescent body increases progressively with its temperature; hence it remained but to find an incandescent material that would withstand the highest temperature. The work of the chemical laboratory of this company in solving this problem has been described by Messrs. W. von Bolton and O. Feuerlein,[a] in a paper entitled "The Tantalum Lamp." As stated by Doctor von Bolton, the task resolved itself into finding a metal not very rare nor difficult to procure whose melting point was above 2,000° C. and which could be easily worked to form a filament.

The vanadium group of metals was experimented with. Neither vanadium nor niobium came up to the requirements of the metal desired, although niobium gave better results than vanadium. Niobium, although having a considerably higher melting point than the vanadium, had a very strong tendency to break up when heated by the electric current. The next metal tried was tantalum, which in

[a] Elektrotech. Ver. Berlin, Jan. 17, 1905, and Western Electrician, Feb. 25, 1905.

many respects is very closely related to niobium, and nearly all minerals that contain one are very apt to contain certain amounts of the other. Doctor von Bolton describes the results of his experiments with the tantalum as follows:

I reduced potassium tantalo-fluoride in the mannér prescribed by Berzelius and Rose and found that the finely divided tantalum so produced became fairly coherent on rolling, so that by this treatment metallic strips of it could be made. It was also attempted to work tantalum oxide into the shape of a filament by mixing it with paraffin and to reduce it directly into the form of a metallic thread. In these experiments there was observed for the first time a minute globule of molten tantalum, and this globule was of sufficient toughness to permit hammering and drawing into wire. Following out this observation, tantalum powder was melted in a vacuum, and then it was found that the highly heated metal parted with the gases it contained. In this manner I produced my first filaments of pure metallic tantalum, which were, however, very small. When these had been used in lamps with promise of good results, an attempt was made to devise a definite process of purification. The potassium tantalo-fluoride was reduced to metallic powder; this powder contains a small proportion of oxide and of hydrogen, which is absorbed during the reduction. When the powder was melted in a vacuum the oxide and absorbed gas disappeared, and a reguline metal remained; on carefully remelting this, it became so pure that no appreciable impurities could be detected in it.

The chemical properties of this pure tantalum are very remarkable, and some of them are of such a nature as to lead me to suppose that nobody other than myself has ever had metallic tantalum in his hands. When cold the material strongly resists chemical reagents; it is not attacked by boiling hydrochloric acid, aqua regia, nitric acid, or sulphuric acid, and it is also indifferent to alkaline solutions; it is attacked solely by hydrofluoric acid. Following the behavior of steel when heated in the air it assumes a yellow tint at about 400° C., and the tint changes to dark blue when the tantalum is exposed for some time to 500° C., or for a shorter time to 600° C. Thin wires of the substance burn with low intensity and without any noticeable flame when ignited. It absorbs hydrogen as well as nitrogen with great avidity, even at a low red heat, and forms with them combinations of a metallic appearance, but rather brittle. It combines with carbon very easily, forming several carbides, which, as far as they are at present known, are all of metallic appearance, but are also very hard and brittle. The product which Moissan thought to be tantalum was clearly a carbide of this nature or an alloy of a carbide with pure tantalum, for Moissan himself stated that his metal still contained one-half per cent of carbon. Considering the high atomic weight of tantalum (183), it is obvious that a very small quantity of carbon suffices to carburize a relatively large quantity of tantalum. This view of the constitution of Moissan's product is confirmed by the properties he ascribed to the metal, namely, specific gravity 12.8, great hardness and brittleness. These are not properties of pure tantalum. When in the form of powder, still containing, as previously stated, oxide and hydrogen, the specific gravity of my material is about 14; when purified by fusion and drawn into wire it has a specific gravity of 16.8 It is somewhat darker than platinum and has a hardness about equal to that of mild steel, but shows greater tensile strength than steel does. It is malleable, although the effect of hammering is relatively small, so that the operation must be rather long and severe to beat the metal into a sheet. It can be rolled as well as drawn into very fine wire. Its tensile strength as a wire is remarkably high and amounts to 95 kilograms per square millimeter, while the corresponding figure for good steel is 70 to 80 kilograms, according to Kohlrausch.

The electrical resistance of the material at indoor temperature is 0.165 ohm for a length of 1 meter and a section of 1 square millimeter (specific conductivity as compared with mercury 6.06). The temperature coefficient is positive and has a value of 0.30 between 0° C. and 100° C. At the temperature assumed by the incandescent filament in the lamp at 1.5 watts per candle power, the resistance rises to 0.830 ohm for a length of 1 meter and a section of 1 millimeter. The coefficient of linear thermal expansion between 0° C. and 60° C. is 0.0000079, according to experiments made by the Imperial Normal-Aichungs Commission. Fusion is preceded by a gradual softening, which appears to extend over a range of temperature of several hundred degrees. The specific heat is 0.0365, so that the atomic heat is 6.64, which is in accord with the law established by Dulong and Petit.

As soon as it had been definitely and positively proved that ductile tantalum could be obtained, physical experiments were at once made as to its actual commercial value in the manufacture of an incandescent lamp. It was first confirmed that tantalum does have a very high melting point and that it is but slightly subject to disintegration in a vacuum, even when subjected to a heavy current. From the very first successful experiments were made in the manufacture of a tantalum lamp, and it simply remained for the physical laboratory to perfect the lamp and bring it up to a commercial basis. The results of these experiments have led to an incandescent lamp consisting of a short glass rod carrying 2 disks into which the arms, bent upward and downward in the shape of an umbrella, are cast. The upper star has 11 and the lower 12 arms, each upper arm being in a vertical plane midway between the vertical planes in which two adjacent lower arms lie. Between these two series of arms, which are bent into hooks at their ends, the entire length of the filament of tantalum is drawn in a zigzag fashion. Its extremities, held by two of the lower arms, are connected with the foot of the lamp by means of a platinum strip. As described by Mr. O. F. Feuerlein:[a]

The standard type for 110 volts, 25 Hefner candlepower, and 1.5 watts per candlepower, has a filament 650 millimeters long and 0.05 millimeter in diameter. The weight of this filament is 0.022 gram, so that about 45,000 lamps contain together 1 kilogram of tantalum. The shape of the glass globe is adapted to the frame described above. Care has been taken to make it of a size not exceeding the usual maximum dimensions of common incandescent lamps of the same candlepower (25 Hefner candlepower, 110 volts). This shape offers a number of noticeable advantages. In the first instance, it is very stable and will stand strong shocks without damage to the lamp. A considerable number of such lamps sent across the sea to test their ability to withstand the hardships of transport came back unhurt, although they had been packed just like common glow lamps, and no special care in any respect had been taken in their handling. The lamp burns, of course, in any position and can therefore be held in any kind of fitting. The light is rather white and agreeable, and its effect is particularly uniform if the lamp is provided with a ground-glass globe.

The life of the tantalum lamp, or the time within which it loses 20 per cent of its initial illuminating power, averages between 400 and 600 hours at 1.5 watts per Hefner candlepower. The absolute life of the lamp amounts to 800 to 1,000 hours under normal working conditions. The illuminating value increases at the beginning, usually

[a] Loc. cit.

after a few hours, by 15 to 20 per cent, and in the same way the consumption of current rises by about 3 to 6 per cent, while the consumption of energy drops to 1.3 to 1.4 watts per candlepower. After this rise of illuminating value, it begins to decrease with a corresponding increase of the consumption of energy.

Another interesting thing regarding these lamps is their behavior when the filament has burnt through. With other incandescent lamps the burning through of the filament would mean that the usefulness of the lamp was at an end. With the tantalum lamp, however, the filament may have been burned through several times without rendering the lamp useless. In some instances such a burning through of the filament is followed by an increase of the illuminating power, this peculiar result being due to the fact that in many cases a broken wire will come in contact with another, thus again establishing the circuit, but at the same time cutting out of the circuit a part of the filament; consequently the lamp burns more intensely. It is possible, if a lamp has a broken filament, to make it again serviceable by simply tapping it to bring the broken piece in contact with another filament. After these lamps have been burning from 200 to 300 hours, the tantalum filament loses to a considerable degree its mechanical resistance and becomes more brittle and will break more easily. Thus, while the new lamps are not very sensitive to strong shocks even while burning, care should be taken after the filament has become altered, after burning 200 to 300 hours, that they are not subjected to any severe shocks.

After tantalum had been proved to be the metal desired for the manufacture of these incandescent lamps, it was necessary to discover or locate a source of supply of this metal. There are quite a number of minerals that contain this metal, which, as has been stated above, is nearly always associated with niobium. Of these minerals, the most common and familiar ones are columbite and tantalite, two minerals that are very closely associated with each other, and are niobates and tantalites of iron and manganese. They pass by almost insensible gradations from a normal columbite, which is the nearly pure niobate, containing about 77.9 per cent of niobium pentoxide and but a trace of tantalum pentoxide, to normal tantalite, which is the nearly pure tantalite, containing about 84 per cent of tantalum pentoxide and only a trace of niobium pentoxide. Of these two minerals the columbite is by far the commoner and occurs in the greater abundance. These minerals occur both massive and crystallized. The crystals are orthorhombic and usually prismatic. They are iron-black to brownish-black in color, and are frequently iridescent. They vary very considerably in specific gravity according to the increase in the percentage of tantalum pentoxide. The nearly normal columbite is 5.3 in specific gravity, while the nearly normal tantalite is 7.8.

These minerals are commonly found in pegmatitic dikes and the columbite is a very commonly associated mineral of these dikes in the eastern part of the United States. Although there are a number of other minerals that contain a high percentage of tantalum, it is very probable that these two minerals will be the ones to furnish the market with tantalum on account of their greater abundance. The most promising localities for obtaining columbite in quantity are near Branchville, Fairfield County, Conn., where this mineral has been found quite abundantly in a pegmatitic dike associated with spodumene. It occurs in large masses and fine crystals, some of which weigh many pounds. At the time this deposit was being worked for spodumene and feldspar a great many barrels of massive columbite were shipped to various universities for experimental work. In North Carolina columbite and tantalite have been found in some quantity in the mica mines of Mitchell and Yancey counties, principally the Wiseman mine of Mitchell County and the Ray mine in Yancey County.

Another promising locality for columbite is the old Etta tin mine and others of the mica and tin deposits of the Black Hills, South Dakota. Some columbite has been found in this district in very large masses. One mass was found which, it was estimated, weighed 2,000 pounds. This locality is the only one from which columbite was produced during the last year, and all of the ore mined was shipped to Germany. There are many other localities throughout the United States where columbite has been found, and any of the pegmatitic dikes, especially of the eastern United States, are favorable localities for prospecting for columbite or tantalite. It may be of interest to give here some partial analyses of some of the columbites and tantalites from the localities mentioned.

Partial analyses of columbite and tantalite from United States localities.

Locality.	Specific gravity.	Nb_2O_5.	Ta_2O_5.	FeO.	MnO.
Branchville, Conn	5.73	60.70	19.20	12.91	7.03
Do	6.59	30.16	52.29	.43	15.58
Haddam, Conn	6.15	51.53	28.55	13.54	4.55
Etta mine, South Dakota (Black Hills)	5.89	54.09	18.20	11.21	7.07
Do	6.37	40.37	41.14	8.28	9.09
Do	6.75	29.78	53.28	6.11	10.40
Bob Ingersoll mine, Black Hills, South Dakota	5.90	57.32	23.43	6.29	13.55
Mitchell County, N. C		70.98	9.27	12.21	7.30
Yancey County, N. C	6.88	23.63	59.92	12.86	3.06
Grizzly Bear Gulch, South Dakota	7.77	6.23	78.20	14.00	.81

There are a number of other minerals that contain tantalum, some of which might become sources of supply of this metal. For the most part, however, they contain much smaller percentages of tantalum pentoxide than either columbite or tantalite, or else occur but very sparingly. Below there is given a list of these minerals, together with their chemical composition and the localities where they have been found.

Minerals containing tantalum.

Hatchettolite.—This mineral is a tantalo-niobate of uranium with calcium oxide and a small quantity of iron oxide. The percentage of tantalum pentoxide in this mineral is about 29 per cent. It is a yellowish-brown mineral, having a resinous luster and occurs sparingly associated with samarskite at a number of the mica mines in Mitchell County, N. C., principally the Wiseman mine.

Samarskite.—This mineral has already been described under the yttria minerals. It contains a much higher percentage of niobium pentoxide than tantalum pentoxide. It occurs in considerable quantity at the Wiseman mica mine in Mitchell County, N. C.

Microlite.—This mineral is essentially a calcium pyro-tantalate, with a considerable variety of other bases in small quantities. It is a pale-yellow to brownish mineral with a resinous luster, which has been found sparingly in octahedral crystals at Chesterfield, Mass., Branchville, Conn., Amelia, Amelia County, Va., where it occurs in pegmatitic dikes, often associated directly with columbite. The tantalum pentoxide in this mineral is about 68.5 per cent. On account, however, of the scarcity of this mineral, it does not represent one that will be apt to become a source of supply of tantalum.

Fergusonite.—This mineral has also been described under the yttria minerals. While it usually contains but from 2 to 10 per cent of tantalum pentoxide, occasionally specimens have been found containing as high as 27 per cent of tantalum pentoxide. It does, however, occur in some quantity, and as a source of both yttrium oxide and tantalum, it may become of some considerable commercial value.

Tapiolite.—This mineral is essentially a tantalate and niobate of iron. It has thus far been observed in but one locality near the village of Sukala, Finland. It has been observed but sparingly and occurs in pyramidal, tetragonal crystals of a pure black color and a strong adamantine luster. Its percentage of tantalum pentoxide is 73.9.

Yttrotantalite.—This mineral has been described under the yttria minerals. Besides the yttrium oxides, it contains 46.25 per cent of tantalum pentoxide, and is another one of those minerals that might become a source of both the yttrium oxides and tantalum. It is, however, of rather rare occurrence, having been found at but few localities in Sweden, principally at Ytterby.

Hielmite.—This rare mineral is essentially a stannotantalate of yttrium, iron, manganese, and calcium, and has been found very sparingly at the Kararfvet mine near Falun, Sweden. Its color is pure black, and it has a metallic luster. It occurs usually massive, without any apparent cleavage, but occasionally it is in rough, orthorhombic crystals. It contains from 54 to 72 per cent of tantalum pentoxide.

With the known deposits of columbite and tantalite it is doubtful whether there will be very much prospecting carried on for these other minerals, as the demand for tantalum must necessarily be limited. The quantity of this metal required in the manufacture of the lamps is exceedingly small, so that a few tons of the mineral will go a long way in supplying the demand for the metal.

PRODUCTION.

During 1904 the production of monazite, columbite, gadolinite, and zircon amounted collectively to 745,999 pounds, valued at $85,038. Of this amount, by far the largest quantity was of monazite. In 1903 the production of monazite and zircon amounted to 865,000 pounds, valued at $65,200. There was a decrease of 119,001 pounds in 1904 in the quantity of these minerals produced, but an increase in value of $19,838. This increase in value is due largely to the purer product of the monazite that was put on the market, and it also accounts for the decrease in the quantity. The larger part of the monazite production was obtained from North Carolina, with smaller quantities from South Carolina. All of the zircon was obtained from North Carolina; all of the gadolinite was produced in Texas, and the columbite in South Dakota. The following table gives the production and value of monazite (including zircon in 1903, and zircon, gadolinite, and columbite in 1904,) mined in the United States from 1893 to 1904.

Production of monazite in the United States, 1893–1904.

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	[a] 865,000	[a] 65,200
1904	[b] 745,999	[b] 85,038

[a] Including 3,000 pounds of zircon, valued at $570.
[b] Including the small production of zircon, gadolinite, and columbite.

IMPORTS AND EXPORTS.

As far as can be learned there were no imports of any of these minerals into the United States during 1904, but there was a very large importation of thorium nitrate, which amounted to 58,655 pounds, valued at $249,904. In 1903 the imports of thorium nitrate amounted to 64,520 pounds, valued at $232,155, and in 1902 the importation was 42,815 pounds, valued at $131,350.

About one-fourth of all the monazite mined in the United States during 1904 was exported to Germany.

PEAT.

By Henry H. Hindshaw.

The peat industry can hardly be said to exist in the United States at the present time. A few small operations are now going on, and a great number of prospective schemes are being exploited.

Interest is taken in the subject wherever peat is known to exist. Many articles on the subject have been printed in the newspapers and periodicals of the country, but these have mostly been of a general character, and little reliable information can be gathered from them, and much of this literature has been positively misleading, especially as to the character of the "mud" which can be made use of. Enough has been done, however, to show that great tracts of more or less pure carbonaceous surface deposits exist in many sections of the country, sufficient to supply large districts with fuel and many industries with raw materials.

The uses to which peat may be put are almost unlimited. Artificial wood, in the shape of ornamental panels, were shown at the St. Louis Exposition. It is mixed with wool to make sanitary "underwear;" and various grades of paper have been successfully made. A cattle food is made in England by saturating peat meal with molasses, and a flourishing industry has thus been established. This feed is said to be becoming popular in the United States.

As a disinfectant and deodorizing agent of the first order, the merits of peat are beyond question. It has for years been extensively used in hospitals and public buildings in England and continental Europe.

It is used for hospital beds and mattresses as well as for bedding for horses. Its power to absorb ammonia is many times greater than that of straw, and by its use stables can be kept free from odors.

The principal interest, however, in peat is as a source of fuel. In its crude condition peat has proved both in this country and in Europe to be useful only under exceptionally favorable conditions, and within a very short distance of the source of its supply. It has been tried on many of our railroads as a substitute for wood and coal, but no record of its extended use can be found, its great bulk and high water content always defeating its application.

These faults, which have always been so self-evident, have led to search for a practical means of overcoming them, and for many years expensive experiments have been carried on with this object. Air drying only partially overcame one of these objections, and the use of heat went little further. It seemed a very simple thing to dry peat and at the same time to reduce its bulk by squeezing out the water. All attempts along this line have proved to be failures, but they are still being made by ingenious mechanics, who think they will attain success with better mechanical devices than have been tried.

Drying peat loosely, either by natural or artificial evaporation of the contained moisture or by a combination of the two and briquetting the dried powder under immense pressure, has proved little more practicable than the attempts at wet compressing.

In Germany and Sweden some success has been attained by pulping the peat with various forms of disintegrating machines and then condensing by moderate pressure.

The reduction in bulk with little reduction of water content shows that the chief result attained is the expulsion of gases. This fact was recognized many years ago by Mr. T. H. Leavitt, of Boston, who designed a machine for this purpose, the expression of the air or gas by the German machines being considered only as a secondary advantage. The ground and kneaded peat was found to give up its moisture freely and to give up a much greater proportion of it than the unprepared peat.

This material, prepared by a variety of methods, is generally known as "machine peat." Its manufacture is inexpensive, and it has shown itself to be an acceptable fuel wherever put on the market, both for domestic and for manufacturing purposes. It is easily made into a peat coal by simply heating in the absence of oxygen, or into peat charcoal by the continued application of heat until the volatile materials are driven off. Much confusion has arisen with regard to this process, it usually being referred to as "coking." Peat does not coke, as the term is understood as applied to coal. Many processes have been devised for the economic production of peat charcoal, which are varied as the completeness of the recovery is desired. The charcoal from well prepared machine peat is strong and dense, the more friable peat resulting in a charcoal having to be briquetted for use as fuel.

The products of distillation of peat are very much the same both in character and proportion as those obtained from hard wood. Experiments are being made with the appliances now in use in the manufacture of wood alcohol in this country, which promise a commercial success.

Another form in which peat is coming into use and which may before many years prove the best means of using it, is as gas. The large proportion of volatile carbon makes it an excellent material for the manufacture of illuminating gas, but as producer gas the peat bog will soon, with the rapid development of the modern gas engine, outrival the mountain stream as a source of power, and its use will not destroy the most beautiful objects of natural scenery, but will, on the other hand, redeem the dismal solitude of the swamp.

Much attention has been paid to peat in Canada for several years past, the object chiefly sought being to produce compressed briquettes. The business is still only in an experimental stage, but some quantity of peat has been put on the market and has sold at a price giving a large profit to the manufacturers. Mr. Alexander Dobson, of Beaverton, Ontario, has a plant turning out peat fuel on a commercial scale at that place. The fuel sells in Toronto at $4.25 per ton, with anthracite selling at $7 per ton.

A company is erecting a plant similar to Mr. Dobson's at Alfred, Ontario, to supply the Montreal and Ottawa markets. Another company, the Manitoba Peat Company, is to operate at Fort Francis, Manitoba, to supply Winnipeg.

The Pompton Fuel Developing Company is producing machine peat near Lincoln Park, N. J., and sells all its product to local consumers. Its success on a small scale will probably result in building a much larger plant this year. The machinery in use was imported from Germany and includes a Dolberg breaker and mixer. This company controls a large acreage of peat land in the vicinity of Pompton Plains, N. J.

Another plant is in operation near New Rochelle, N. Y., by the Peat Koal Company, of New York, which uses a Schlickeysen machine. At Orlando, Fla., machine peat is manufactured on a machine designed by Mr. T. H. Leavitt, of Boston.

In Mexico much experimental work has been done on a very large peat deposit near the City of Mexico with more or less success. One of the most interesting developments has been in California. Mr. L. E. Aubury, State mineralogist, states that there are many thousand acres of peat in California. A company has been organized for the purpose of manufacturing briquettes composed of peat and oil. Some tons of fuel have been made and tested, both for domestic and steam-raising purposes.

A very practical test was made by the California Northwestern Railroad. A train of 10 cars was run over the same track a distance of 60 miles first with coal and then with peat briquettes. There were 4,450 pounds of coal used and the time consumed was two hours and forty-six minutes. The run with peat briquettes was made in two hours and forty-one minutes and 5,100 pounds of fuel were used. The quantity of ash taken out was 914 pounds from the coal and 939 pounds from the peat.

A large plant is now being erected to manufacture this fuel. A number of companies have been organized in the Middle and Northwestern States to produce peat fuel by various methods. Some of these are building plants to operate during the summer of 1905. Others do not seem to have advanced beyond the prospectus stage. Many of them promise extraordinary profits by the use of patented processes, often involving the use of electric devices at some stage of the manufacture.

There are many other experimenters quietly at work, and it seems probable that at least some of them will prove commercially successful, and will point out the way to make use of the immense quantities of energy now lying dormant.

The production of peat in 1904 is estimated as amounting to about 1,200 tons, valued at $4,200.

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List of patents relating to the treatment and manufacture of peat issued from 1899 to June, 1905.

No.	Date.	Patentee.	Title.
621802	Mar. 28, 1899	A. A. Dickson	Manufacturing peat into blocks of fuel.
621923	do	H. Kerrinnes	Producing press-peat.
663568	Dec. 11, 1900	L. Galecki	Working peat and manufacturing same into briquets.
645226	Mar. 13, 1900	G. Gercke	Peat-burning apparatus.
658281	Sept. 18, 1900	A. Rom	Machine for treating peat.
657907	do	J. Ahrens	Machine for treating peat to be used as fuel.
690363	Dec. 31, 1901	C. Esser	Apparatus for the production of half-stuff from peat.
688014	Dec. 3, 1901	J. W. Carswell and S. Trotter.	Peat-drying apparatus.
665619	Jan. 8, 1901	E. Springborn	Relating to drying and condensing peat for fuel, etc.
682059	Sept. 3, 1901	J. O. Green and H. T. Martin.	Machine for converting peat into compact nonfibrous substances for use as fuel.
685651	Oct. 29, 1901	W. J. R. Sims and A. L. Davis.	Means for extracting roots and foreign matter from peat.
685650	do	do	Treating and drying peat.
700421	May 20, 1902	E. Helbing	Manufacturing peat briquets.
714578	Nov. 25, 1902	G. Hartmann	Producing peat briquets.
713129	Nov. 11, 1902	W. A. Milne	Peat-collecting machine.
713128	do	do	Peat dryer.
709664	Sept. 23, 1902	A. Charon	Preparing bog-peat for fuel purposes.
713110	Nov. 11, 1902	R. A. Kellond	Manufactured peat fuel.
715271	Dec. 9, 1902	do	Do.
700190	May 20, 1902	J. O. Green and H. T. Martin.	Converting peat into fuel.
701311	June 3, 1902	A. Dobson	Peat-press.
701856	June 10, 1902	A. A. Dickson	Do.
708574	Sept. 9, 1902	W. A. Milne	Do.
738561	Sept. 8, 1903	do	Composite peat block.
738136	Sept. 1, 1903	F. White	Block of peat.
735476	Aug. 4, 1903	A. Dobson	Pressing peat blocks.
736446	Aug. 18, 1903	C. F. Schlickeysen	Peat digging and conveying machine.
744805	Nov. 24, 1903	do	Peat digging and excavating machine.
738135	Sept. 1, 1903	F. White	Forming peat into blocks for fuel.
738090	do	do	Apparatus for compressing and drying peat into blocks of peat.
722626	Mar. 10, 1903	N. Reif	Manufacturing plastic objects from peat.
772717	Oct. 18, 1904	B. Kittler	Apparatus for removing water from peat.
768445	Aug. 23, 1904	T. W. Gaertner	Manufacture of peat blocks.
769170	Sept. 6, 1904	B. Kittler	Peat-brick-manufacturing machine.
752064	Feb. 16, 1904	J. O. Green and H. T. Martin.	Consolidating peat.
771202	Sept. 27, 1904	C. Esser	Apparatus for the treatment of peat fiber for manufacturing half-stuff.
773992	Nov. 1, 1904	C. T. Schlickeysen	Manufacturing peat fuel.
758624	May 3, 1904	A. Dobson	Peat-harvesting machine.
756129	Mar. 29, 1904	W. A. Milne	Treating peat immediately prior to compression.
755674	do	R. A. Kellond and J. C. Morrison.	Machine for manufacturing peat into blocks for fuel.
772891	Oct. 18, 1904	B. Kittler	Removing water from peat.
775137	Nov. 15, 1904	W. T. Griffin	Peat-treating apparatus.
769531	Sept. 6, 1904	E. Bremer	Oven for coking peat with recovery of by-products.
782260	Feb. 14, 1905	W. A. Milne	Tubular peat collector.
782587	do	J. W. Vaughan and C. S. Horner.	Preparing peat for fuel.
785637	Mar. 21, 1905	C. Schlickeysen	Peat-compressing machine.
788100	Apr. 25, 1905	W. T. Griffin	Treating peat.
789758	May 16, 1905	P. Reynolds and J. A. R. Bedard.	Wet-peat-pressing machine.

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